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POLLUTION OF LAKE SUPERIOR AND ITS TRIBUTARY BASIN IN THE STATES OF MINNESOTA, WISCONSIN, AND MICHIGAN. PROCEEDINGS OF CONFERENCE, SESSION (2ND) HELD AT DULUTH, MINNESOTA ON APRIL 29-30, 1970. VOLUME I

Federal Water Quality Administration
Washington, D.C.

1970

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PB 229 623

PROCEEDINGS

Minnesota
LAKE SUPERIOR
Wisconsin
Michigan

Second Session
April 29-30, 1970
Duluth, Minnesota
Vol. 1

CONFERENCE

In the Matter of Pollution of Lake Superior and its Tributary Basin – Minnesota – Wisconsin – Michigan

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U.S. DEPARTMENT OF THE INTERIOR ● FEDERAL WATER QUALITY ADMINISTRATION

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ii

SECOND SESSION
OF THE
CONFERENCE
IN THE MATTER OF POLLUTION OF LAKE SUPERIOR AND ITS TRIBUTARY BASIN IN THE STATES OF MINNESOTA, WISCONSIN, AND MICHIGAN

held in

Duluth, Minnesota

April 29 - 30, 1970

TRANSCRIPT OF PROCEEDINGS

CONTENTS

PAGE

Opening Statement - Mr. Stein.................. 5

Hon. P. A. Hart............................ 10

B. H. Atwood.............................. 12

G. J. Merritt............................. 15

C. H. Stoddard............................ 34

Dr. C. E. Carson.......................... 41

Mrs. A. Harvell........................... 51

B. Meyers................................. 58

J. T. Shiner.............................. 61

M. Hanson................................. 72

B. Haglund................................ 75

M. T. Downing............................. 78

Dr. G. R. Gleason......................... 81

D. Zemtner................................ 86

G. Nelson................................. 91

R. Hellman................................ 95

B. L. Brommer............................. 98

D. Davidson.............................. 100

F. T. Mayo............................... 103

C. Fetterolf............................. 108

CONTENTS

(Continued)

PAGE

M. Gamet 176, 385

E. Terpstra 203

G. Jarecki 215

Dr. D. I. Mount 220

Hon. G. Nelson 383

T. G. Frangos 387

R. J. Courchaine 448

T. Griffith 558

P. A. Doepke 565

J. L. Carter 568

J. P. Badalich 570

R. Koenig 626

E. T. Fride 631

K. Haley 780

Dr. C. W. Huver 858

Summary 868

- - -

report [illegible] concerning

The Second Session of the conference in the matter of pollution of Lake Superior and its tributary basin in the States of Minnesota, Wisconsin, and Michigan, convened at 9:30 o'clock on April 29, 1970, at the Hotel Duluth, Duluth, Minnesota.

Included are: Statements, discussions, water quality standards, and related information

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PROCEEDINGS

OPENING STATEMENT

BY

MR. MURRAY STEIN

MR. STEIN: The conference is open.

This Second Session of the conference in the matter of pollution of Lake Superior and its tributary basin in the States of Minnesota, Wisconsin, and Michigan is being held under the provisions of Section 10 of the Federal Water Pollution Control Act as amended. Under the provisions of the Act, the Secretary of the Interior is authorized to initiate a conference of this type when on the basis of reports, surveys, or studies he has reason to believe that pollution subject to abatement under the Federal Act has occurred.

This conference first met on May 13 to 15, 1969, and met in Executive Session on September 30 and October 1, 1969.

As many of you know, we are dealing with one of the most precious and clean water resources in the

United States in Lake Superior. We are dealing with a very, very complicated problem, and as all the testimony at the first conference showed and the large amount of material which came out later and the public interest in this, we need all the help we can get if we are going to come up with an equitable solution to the problem and keep the waters of Lake Superior as well as the other Great Lakes in fresh, clean condition for present and future uses, to use them ourselves, and to hand them down to future generations.

I have said this before, but I think it bears repeating. The Great Lakes are the greatest single source of freshwater in the free world. The miracle has been that they have remained fresh so long. I think we have had pretty good indisputable evidence that we are seeing premature signs of aging of the lakes, the kind that happens when civilization is around a fresh body of water, the kind of aging that we have seen in lake after lake in Asia Minor and in Europe that have had the impact of civilization through the centuries.

The question here is, can we afford to let this rate of deterioration go on in the Great Lakes or are we going to take action to preserve it? I don't think all the old conceptualisms that you might have had are going to help the problem, that is this notion of Federal rights, States rights, local rights, industrial rights, and so forth. I think this is a problem of survival and a problem that we all have to work on together if we are going to come up with the answer. I think in that spirit all the parties vitally concerned with this problem have been working toward its solution.

At the last session of the conference we asked that the States follow through on the various sources of pollution and of various discharges into Lake Superior. Again I would like to indicate we are dealing with a multiplicity of discharges and not just one. The cleanup of any single discharge is not going to save Lake Superior as it wouldn't save Lake Michigan or save Lake Erie or Lake Ontario. We have to get at all sources, large and small, every one of them painstakingly, to do it.

But due to the interest in the Reserve Mining Company, we have asked them to undertake further engineering and economic studies relating to possible ways or means of reducing by the maximum practical extent the discharge of tailings to Lake Superior. Secretary Hickel specifically recommended that Reserve Mining have a working copy of their report ready by this time, and we will call on Reserve Mining representatives sometime during this conference and if they have that report ready, of course this will be considered by the conferees.

Again I would like to point out the statutory rules of the conference. This is a conference between the Federal Government and the State agencies. The State agencies representing Minnesota, Michigan and Wisconsin are here with the Federal representatives. These constitute the conferees. All the other people are invitees. And as in the past, we will have presentations of views from members of the public and the official agencies.

We are going to reverse the procedure that we had last time, since the factual basis has been laid by the official agencies. That is, last time we had the Federal and State agencies present their material first. This time we are going to give the citizens groups, the nongovernmental agencies, an opportunity to present statements first.

I have a list of some of the people who will present statements, but if you want to get on I would suggest, if you have not gotten your name up to me or one of the State agencies, that you get in touch with Mrs. Rheta Piere.

Mrs. Piere, would you stand up? She has the nice bright yellow dress on, so you can spot her. Get your name to her and you will be called on.

I would like the panel members here to introduce themselves. Could we start at the far end?

MR. TUVESON: Robert Tuveson, Minnesota PCA.

DR. ANDERSEN: Howard Andersen, Minnesota PCA.

MR. BADALICH: John Badalich, Minnesota Pollution Control Agency.

MR. FRANGOS: Tom Frangos, Department of Natural Resources, Wisconsin.

MR. MACKIE: Don Mackie, Department of Natural Resources, Wisconsin.

MR. MAYO: Francis Mayo, Regional Director, Federal Water Quality Administration, Chicago.

MR. BRYSON: Dale Bryson, Federal Water

Quality Administration, Minnesota.

MR. PURDY: Ralph Purdy, Michigan Water Resources Commission.

MR. FETTEROLF: Carlos Fetterolf, Michigan Water Resources Commission.

MR. STEIN: My name is Murray Stein. I have been designated by Secretary Walter J. Hickel as the Chairman of the conference and am the representative of Mr. Hickel.

Before we start, I would like to read a telegram addressed to me. The telegram reads:

"Regret unable to be at your conference but would like to urge that necessary steps be taken to stop all pollution of Lake Superior from whatever source without further delay. Would appreciate your reading this telegram into the record."

Signed Philip A. Hart, United States Senator from Michigan.

We are having Mrs. Virginia Rankin make a verbatim transcript of the record here. Mrs. Rankin is an independent contractor. We generally have the transcript available in several months and the States will make a distribution to you. However, if anyone wants a copy of the transcript beforehand or a portion of that transcript, get together with Mrs. Rankin and make your own arrangements with her, and, of course, if you make satisfactory arrangements you can have the copy.

A word about procedure. We would like all participants in the conference other than the conferees to come up to the podium to make their statements and identify themselves for the purposes of the record. If you have copies of your statement, the conferees will appreciate having them, but the first priority is to give your copy to Mrs. Rankin so she can have an accurate description of what you put forth. I can't urge this on you too strongly, because this is quite a chore for someone to stay here and take this down all day.

With that, we will first call on Burton H. Atwood, the Regional Coordinator for the Department of the Interior, for a short statement.

Mr. Atwood.

BURTON H. ATWOOD, REGIONAL COORDINATOR
OFFICE OF THE SECRETARY
U. S. DEPARTMENT OF THE INTERIOR
DES PLAINES, ILLINOIS

MR. ATWOOD: Mr. Chairman, conferees and ladies and gentlemen.

My name is Burton H. Atwood. I am with the Office of the Secretary of the United States Department of the Interior.

It is really a pleasure to come to Duluth again today where it is still possible to get a breath of fresh air and to look over the sparkling waters of Lake Superior, which contributes so much to your economy.

The Department of the Interior has a broad range of interests in this hearing, in addition to that of the Federal Water Quality Administration, which is a participant in the conference. Our Fish and Wildlife Service, Bureau of Indian Affairs, Bureau of Mines, Bureau of Outdoor Recreation, the National Park Service, and the Geological Survey have specific responsibilities in the development of this area and are, consequently, vitally concerned with what we accomplish here.

Today we are playing in an entirely different ball game than existed at our first session almost a year ago.

The people of the United States have indicated that they care deeply about the quality of life they have and they know that the processes that produce our material wealth are the same processes that foul our air, poison our lakes, destroy our land and kill our wildlife.

But they feel that they are hiring us to protect these resources and somehow they have been led to believe that something is going to be done about it. Now, I am afraid that they may become impatient if we can't show some progress.

President Nixon has said:

> "We no longer can afford to consider air and water common property, free to be abused by anyone without regard to the consequences. Instead, we should begin now to treat them as scarce resources, which we are no more free to contaminate than we are free to throw garbage in our neighbor's yard."

Secretary of the Interior Walter Hickel has committed us to a policy of preventing further deterioration of the country's water supplies and calls for "use without abuse."

So I think the time has come to forget jurisdictions, to forget additional studies and collectively get off our "duffs" and get on with the job.

Secretary Hickel likes to recall his boxing days. He believed in beating an opponent in the earliest round possible. He found it the most economical, the most effective and the best way to have all the fans in your corner.

Collectively, we have the resources and experience to knock out pollution. We may have missed a little in the first round and the points may be counting up against us, but by meeting the challenge now it will be the least costly, the most efficient way to win, and we will have the people for us and not against us.

MR. STEIN: Thank you, Mr. Atwood.

Are there any comments or questions from the conferees?

Next we would like to call on Mr. Grant J.

Merritt.

GRANT J. MERRITT
LAKE SUPERIOR TASK FORCE CHAIRMAN
MINNESOTA ENVIRONMENTAL CONTROL
CITIZENS ASSOCIATION, MINNEAPOLIS, MINNESOTA

MR. MERRITT: Mr. Chairman, conferees.

As Lake Superior Task Force Chairman of MECCA--and I am really not the only one representing MECCA; there are some 3,000 members of this Minnesota Environmental Control Citizens Association--it is a pleasure to again address this important conference called to end the pollution of Lake Superior.

One year ago MECCA called for immediate action to stop the dumping of taconite tailings in Lake Superior, and strong action to stop the spoilation and exploitation of this greatest body of water in the world. Since this conference convened one year ago, the only visible results are exactly what we feared the most--"endless study."

Despite the increasing, convincing, and in many respects conclusive evidence of the degradation of

Lake Superior's waters, we still have no action to end the dumping. Gentlemen, we again call for strong measures to stop this destruction. There is much talk about solving the problem, but unless we adopt a "get-tough" policy immediately we will all be consumed by the rhetoric while Lake Superior is lost forever.

What you gentlemen decide here on the question of taconite tailings pollution of Lake Superior by Republic and Armco Steel Corporations, operating through their subsidiary, Reserve Mining Company, will have profound repercussions throughout our land. If Reserve Mining Company is required to stop this monumental destruction of Lake Superior, and stop it forthwith, there will be hope for the future of our environment. If not, the results will be disastrous.

This is a test case. It will be a landmark if we take this strong action and the results will be far-reaching in their effects on other major pollution problems in the United States. This case might be titled, therefore, The People Versus Reserve Mining Company, a test case.

A brief review of Reserve's attitude

G. J. Merritt

and the events since the May 1969 conference is not encouraging. Following the May conference session, Reserve hired Max Edwards, former Assistant Secretary of the Interior, and Clark Clifford, former Secretary of Defense as their Washington lobbyists. The policy of Reserve Mining Company in hiring these former top Government officials is highly questionable. Just last month, for example, a secret meeting arranged by Secretary Clifford, and attended by Reserve officials and Congressman John Blatnik, was held in Washington, D. C., with General Clarke, Chief of the U. S. Army Corps of Engineers. As everyone now knows, this issue of tailings pollution of Lake Superior is of tremendous citizen concern. Yet Reserve Mining Company arranged a secret meeting in order to persuade General Clarke that the Federal Permit issued by the Corps to Reserve should not be revoked. If Reserve has nothing to hide, we ask, why didn't they notify the news media of this meeting? This kind of secrecy is inexcusable--yet secret meetings between Reserve and the Federal and State governments and suppression of important information have become the order of the day in this "taconite affair."

Since the Stoddard report was issued on December 31, 1968, Reserve Mining Company has never wavered in its constant efforts to suppress information, secretly influence Government officials, attempt to perpetuate its "density current theory," which plainly does not work, and deny any and all criticism of its operations. This shocking corporate attitude underscores the urgent need for far-reaching reforms in our system. It is clear that Reserve will never end its dumping unless forceful action is taken now. MECCA deplores the continuing effort of Reserve Mining Company to influence U. S. Government agencies by hiring the former heads of those same agencies. We believe the public recognizes and will not stand for this attitude, which might be described as "let the public be damned," which is reminiscent of another era in American history, the "Robber Baron" days of the 1890's.

The public is tired of the delays, the foot-dragging and the stalling tactics of the Reserve Mining Company and the State of Minnesota.

While the public clamors for action to end this tailings pollution, Reserve Mining has engaged in stalling tactics designed to hold off any action whatsoever. Just three examples of this stalling and foot-dragging by Reserve Mining Company.

Recently Reserve Mining sued the State of Minnesota alleging that the WPC-15 Federal-State water quality standards were adopted illegally or, in the alternative, that Reserve should be granted a variance because enforcement would cause undue hardship in their work. One could only hope that Reserve would show the same concern for the hardship resulting from their continuing destruction of Lake Superior's pure waters.

Secondly, Reserve has moved to postpone the State of Minnesota hearing ordered by Judge Donald Barbeau, Hennepin County District Judge, to determine whether Reserve is violating its State dumping permit.

And then third, Reserve has sought weak recommendations or no action whatsoever from this enforcement conference, has attacked Secretary Hickel's recommendation that the Federal permit be, in effect, revoked and has, in general, used every means at its disposal to delay the action it knows is inevitable.

G. J. Merritt

Unfortunately, the State of Minnesota has participated in this footdragging ever since the Stoddard report was released. In the first place, after the Stoddard report became public on January 16, 1969, John Badalich of the Minnesota Pollution Control Agency blasted it as containing "irresponsible interpretation," "speculation and conjecture," and numerous errors.

Secondly, Governor LeVander of Minnesota has refused to formally join this conference, thereby seriously undermining efforts to obtain a solution to tailings pollution through this conference.

Third, at the Executive Session of this conference, which you remember last fall was held here in Duluth, Minnesota, representatives repeatedly objected to strong action by this conference, particularly the strong action called for by Wally Poston. Gentlemen, we think Mr.Poston was right and his suggestions should have been followed. (Applause.) Instead, the weak recommendation for further study, sponsored by the State of Minnesota, of ways and means of reducing to the maximum practicable extent the amount of tailings

G. J. Merritt

discharged in the lake was adopted, and Reserve's "Progress report" of these ways and means will soon be before this conference.

Fourth, the State of Minnesota, represented by Attorney General Douglas Head, vigorously opposed the action of two citizen conservation groups, the Sierra Club and the Minnesota Committee for Environmental Information. These conservation organizations sought and successfully obtained, over the opposition of the State of Minnesota, a writ of mandamus requiring the pollution control agency to hold the hearing I mentioned earlier to determine whether Reserve is violating the terms and conditions of its State dumping permit.

Fifth and finally, the Minnesota PCA has recently gone on record with the Corps of Engineers opposing Secretary Hickel's recommendation which calls for revocation of the Federal permit. This in effect means that the State of Minnesota is now opposing the higher standards recommended by Secretary Hickel for Lake Superior, which is in ironic contrast with the position of the State of Minnesota in connection with nuclear power radioactivity pollution where the State

G. J. Merritt

of Minnesota is saying the Atomic Energy Commission, the Federal Government, doesn't have high enough standards, therefore we will adopt higher standards. Fortunately, we do have some support from the Federal Government and that support is more encouraging.

Secretary Hickel's letter dated February 11, 1970, to General Clark, Chief of the Army Corps of Engineers, is a significant step forward in the battle to save Lake Superior from the tailings. He recommended that Reserve modify its method of discharge so as to prevent any portion of the tailings from going beyond the three-mile limit around the plant, either at the surface of the waters, below the surface of the waters, or on the bottom of Lake Superior.

Since Reserve cannot possibly modify its dumping operation in order to meet these conditions, Secretary Hickel was really saying the Federal permit should be revoked. For this we commend him highly. We only wish that he had shown courage enough to recommend the same strong action through his own Department of the Interior. Instead of accepting the weak recommendations adopted by this conference last fall, Secretary Hickel could have called for a complete end to the tailings discharge. He has the authority to go beyond the recommendations of these conferees. Moreover, because of bureaucratic delay in Washington, it was four months before Secretary Hickel signed the recommendation proposed by this conference on October 1, 1969. However, in view of Secretary Hickel's strong stand in February, we now urge this conference to follow his lead and recommend revocation of both the State and Federal permits.

We have also recently had help from another source in Washington, Senator Walter Mondale. We are most encouraged by Senator Walter F. Mondale's courageous speech here in Duluth last week in which he called for revocation of both the Federal and State permits. In view of the political situation in this area, this step was not an easy one for Senator Mondale, but he has the courage of his convictions and we applaud him for the forthright stand which he has taken. (Applause.) With this kind of help from Washington, perhaps there is hope for the future of Lake Superior.

It is time, gentlemen, to end the procrastination and get on with the adoption of strong action.

It has been said that the earth is going to hell in a wastebasket. Applied to Lake Superior, it may be said that Lake Superior is going to hell on a chute. As a matter of fact, two chutes, from Reserve Mining Company and Silver Bay. While pollution pours into Lake Superior by the millions of tons, we debate how we can establish new committees to study the problem. This pattern of procrastination on the life of Lake Superior is totally unacceptable. We cannot stand still for endless studies, months dragging into years of delay while the pollution reaches epidemic proportions. Gentlemen, the time for study has ended. The time for action is now.

We all know that the State of Minnesota permit has been violated in several respects:

First, material quantities of matter soluble in water are being discharged into the lake.

Secondly, there is material clouding or discoloration of the water at the surface outside of the three-mile zone specified in the permit around the plant.

And third, the tailings are a public nuisance.

Despite these violations, Reserve has been allowed to proceed as usual this past year.

In view of the entire situation, we ask this conference to adopt the following four recommendations at this session:

1. Revocation of Reserve's Federal and State permits as of December 31, 1970, the end of this year.

In the meantime, we ask for this conference to direct Reserve to begin immediate construction of on-shore disposal facilities in accordance with the Stoddard report.

Then if Reserve Mining Company has undertaken such construction and has progressed satisfactorily during the remainder of this year toward on-shore disposal facilities by December 31st of 1970, at that point conditional permits could thereafter be issued until the construction is completed no later than December 31, 1972.

And then 4th, we urge you to adopt the following finding, that no further study is needed.

In conclusion, today is Earth Day plus seven.

G. J. Merritt

If Earth Day and all the talk we heard last week about saving the environment means anything, we must translate this rhetoric into swift action. Gentlemen, you represent the establishment and the burden of responsibility is yours. The seeds of revolution are sown and are stirring in the United States today and we cannot allow violent revolution to occur. But neither can we allow the violence of pollution, which is already occurring, to continue.

As Ralph Nader has stated, pollution is indeed violence. It is more sophisticated, perhaps, but violent, nevertheless, because of its insidious impact on the environment. This violent destruction cannot be allowed to continue, yet continue it does. The failure of the State and Federal Governments to stop this violent destruction by Reserve Mining Company which is destroying Lake Superior and its failure to do anything over the last 16 months since the Stoddard report was issued raises really frightful possibilities.

Gentlemen, the challenge is here. The public demands action now. The question is, how will you respond? We must accept the bold challenge as expressed by millions on Earth Day to save mankind from extinction. If we do, we will move ahead with solutions that were mere dreams yesterday.

We can, we must, gentlemen, stop the dumping of tailings. We call on you to move clearly, definitely, sincerely, even energetically, and, above all, immediately to stop the further destruction of Lake Superior.

Thank you very much. (Applause.)

MR. STEIN: Are there any comments or questions?

You don't have to leave, Grant, because I have one or a couple.

I have said many times, we wouldn't need a panel like this or perhaps a good lawyer like you in dealing with pollution problems if all you had to do was shut down an industry to control it. Anyone can do that. I think the challenge is to keep the industry alive if possible and to control pollution.

We also have in this, as a basis of the recommendations, a distressing number, I find, of ad hominem arguments of respected members of the bar being indicated as holding secret meetings. Not that I was at any of these meetings, but I didn't find any of this attitude of secrecy, and so forth and so on.

Again I think, as I said in my opening remarks, unless we forget this conceptualism, unless we all try to work this out together, I am not sure we are going to come up with an equitable solution. This conference made a judgment after hearing all the testimony at the last conference on a method and procedure to be followed where we were going to find the facts and follow certain studies and try to come up with an agreed-upon judgment.

Mr. Merritt, of course it is your privilege not to agree with the conference's recommendations, and I think it is pretty clear with this that you haven't changed your position one bit from what it was in the first statement you made. You just have not agreed with the procedure we are undertaking here and you are suggesting we reverse it.

MR. MERRITT: That is correct, Mr. Chairman, except with one exception. I think that right now we are asking for even stronger action than we did a year ago because of what has happened in the past year, not only with regard to Reserve's hiring of these Washington lobbyists and members of the bar, but also because of the State of Minnesota. As I have described, I have given you five examples. There are more.

I don't think the conferees and perhaps you, Mr. Chairman, realize the seriousness of this problem. I mentioned the seeds of revolution are stirring in our land today. I don't think that the governments, at least from the evidence over the past year, realize the impact of this continual study. About all we think we can expect from this conference session during the next two days is another committee or to wait for Reserve's final report, which may come in sometime in July. Well, what kind of action is that? I don't think this conference realizes how serious the problem is.

MR. STEIN: Well, I think I understand your point of view. I also think that it is characteristic of people who think there is a conspiratorial form of government or action in a particular area that everyone else does not have a notion of the seriousness of what the problem is about.

MR. MERRITT: Well, as Ralph Nader has pointed out, Mr. Chairman--

MR. STEIN: Pardon me, I think I waited until you finished, Mr. Merritt.

MR. MERRITT: I am sorry. I thought you were through. Go right ahead.

MR. STEIN: You may or may not disagree with the judgment of the conference. I have known many of these people for many, many years. In dealing with them at the last conference and over the past several months, I believe they recognize the scope and seriousness of the problem. They are really alive and well people here.

Of course, you took the one man we had here who is no longer working with our organization and elevated his ghost to that of a hero. That is great, too, because I like the guy. But I wonder if that kind of tactic will help solve the problem, Grant, I really wonder.

MR. MERRITT: Well, we have several heroes, I think, that we could go on. Wally Poston is certainly one of the foremost and finest Federal Government employees that we have seen and he stood up here, and it took courage, last fall to make his recommendations. I think that he should be recognized and I think it was very proper to recognize him here today, because this does go in the official transcript of this proceeding, as I think you realize.

MR. STEIN: Again, no one has worked more closely with Wally Poston during his career in this field than I have, and I think everyone who is familiar with this knows that. We have been close friends and colleagues for 25 years.

But again, it is passing strange to bring up the guy who just doesn't happen to be here because he changed his employment and make him the hero because he isn't here to follow through with his statement.

MR. MERRITT: But why was his employment changed? That is the question.

MR. STEIN: Do you think that is a proper subject for this conference? That is the kind of thing that I don't think is going to help clean up Lake Superior.

MR. MERRITT: Yes, but neither, Mr. Chairman, is the kind of thing that went on in Washington last month where Secretary Clifford called a secret meeting with Reserve Mining Company without notifying any members of the press and the Federal Government went right along with them. The Corps of Engineers could have notified the press so we would know what was said and that the Federal Government and the industry were working together at that point. That is what is wrong with what hasn't happened in this question.

MR. STEIN: I guess you didn't get the point yet.

MR. MERRITT: Well, I think I agree. Apparently we are at a little loggerhead.

MR. STEIN: The fact that you keep referring to it as a secret meeting and repeating that again and again by no means makes it a secret meeting except that you keep saying it.

MR. MERRITT: Why wasn't the press notified, then? It was a secret meeting and there has been government suppression as late as last week. I could cite a dozen examples of what has been going on in this past year. The Corps of Engineers right now refuses to release to the press and the public statements which were submitted in accordance with the request of Colonel McGinniss, the Chief of the District here in St. Paul in

Minnesota. This is not an isolated example, Mr. Stein. This is going on repeatedly.

MR. STEIN: Mr. Merritt, again I think we have the thrust of your argument. If you think that those ad hominem arguments where you are pointing out people and places and alleged secret meetings and pointing to these things as significant factors are going to be an aid in solving this problem that we are all wrestling with, bless you. But I think we have your view.

Are there any other comments from the conferees?

Go ahead. You have the last word or as many as you wish.

MR. MERRITT: No, I think I have spoken enough, Mr. Stein. Thank you very much. (Applause.)

MR. STEIN: Thank you.

Now, I know there is someone else from MECCA, but before that we would like to call on Mr. Charles Stoddard. You know, I have lived in Virginia for 25 years and the kids still think "damn Yankee" is one word. I have known Charles Stoddard for many years, too, and I knew him before his name was "Stoddard Report." (Laughter.)

CHARLES H. STODDARD
RESOURCE CONSULTANT, WOLF SPRINGS FOREST
MINONG, WISCONSIN

MR. STODDARD: Mr. Chairman, conferees and citizens concerned about the future of Lake Superior.

I want to lay a ghost to rest. I am not a ghost.

I do want to extend a hearty welcome to the fold to those of you who have finally embraced the compelling logic and the eternal verities of the highly controversial Interior Department report. A year ago every effort was made by high public officials to dispute and discredit the report which pinned the tailings on the taconite polluting donkey of Silver Bay.

We have come a full circle. Last February Secretary of the Interior Walter Hickel wrote a letter to the Chief of the Army Corps of Engineers formally endorsing the Interior Department study report and urged him to require Reserve Mining Company in its revised permit to clean up its highly polluting effluent. If these encouraging words are followed similarly by those who sought to discredit the report with a will to come down hard on the polluters of this magnificant lake, all will be forgiven.

In facing up to this enforcement issue, we have several major issues which will test the whole concept of and the value of our water pollution laws as effective tools in cleaning up our dirty environment. It is fitting that the basic test of these laws comes immediately after E-Day--1) on our largest Great Lake, 2) with one of the Nation's major polluting corporations, 3) in the district of the congressman who authored the basic legislations.

These questions will face you gentlemen who are conferees and in whose hands the public has entrusted the job of environmental management.

Probably the first and relatively simple question is whether the small polluters whose septic tanks leak into Lake Superior will feel the strong arm of law enforcement while the big ones with their passports from the big economic interests buy time with their well-paid lawyers, lobbyists and so-called scientific consultants with legal ruses to stall action.

A more fundamental test of the effectiveness of the whole legal and administrative system which has developed since 1956 faces you. There is little evidence that the complex pollution control structure is really producing clean waters. In fact, not one river or lake, to my knowledge, is in better shape than it was 14 years ago.

The reason? Not because of the will on the part of the administrators, but because public agencies are expected to prove that effluent from each source is a pollutant rather than to require the polluter to prove the quality of his effluent as being harmless.

Now we are faced with more procedural problems in a complex web of State-Federal relationships which enable agencies to pass the buck while polluters merely profit from the further environmental degradation.

All this adds up to study, study, study, delay, delay, delay. All of this procedural footdragging leads us today to a direct challenge to cut the Gordian knot. But you will be told again and again by certain spokesmen that taconite tailings are merely sand despite overwhelming evidence to the contrary.

In this day of advanced geology and soils technology Webster's definition that sand is ground up rock lacks precision. The professional textbook on the subject is W. H. Twenhofel's Principles of Sedimentation, in which he sets forth Wentworth's size classification of various particles of materials, sand, silt and clay:

Sand ranges in diameter from 2 millimeters to 1/16 millimeter.

Silt ranges from 1/16 to 1/256.

Clay is less than 1/256 or 4 microns.

The U. S. Geological Survey reported that 90 percent of the Reserve Mining Company's tailings were less than 4 microns, that is clay particles, equivalent to 5,400 tons of daily discharge. An even larger proportion is in silt size particles. Therefore, to identify this material, as it is constantly called in the press and other places, as sand is inaccurate. Clay and silt particles are circulating in Lake Superior from the Silver Bay source.

Another matter, Reserve Mining Company's own data shows less than half of the tailings are in the Reserve delta.

I did not come here today to split definitions, though I did want to lay that repeated piece of information to rest.

One other significant fact needs to be pointed out. This interminable footdragging, legal procedure, political manipulation is not unknown to one of Reserve's two owners, Republic Steel. The record shows that it has taken five years for the city of Cleveland to get enforcement action on a fantastic air pollution problem caused by Republic.

Republic is now in the courts in Chicago and Cleveland for nearly outright defiance of water pollution enforcement actions.

Perhaps it is time for the people in northeastern Minnesota to look again at this so-called good corporate citizen who is using the law to continue its profitable damage to our Lake Superior environment.

It is time to call a spade a spade. Pollution is taking place in violation of the Minnesota State permit. This permit must be amended to provide for on-land tailings disposal or revoked. Despite a recent news release which purports to require that the State must certify to the U. S. Army Corps of Engineers that Reserve is violating State water quality standards, the Corps can act on its own motion and should without further delay.

This conference is now nearly a year old. Some progress is evident and more is needed. The people in this area want Lake Superior cleaned up now. If the great national demand for clean environment was loud and clear last week, this conference can strike a blow this week by positive action today. Anything less will be a discredit to the law, its proponents and its administrators.

If it fails, all of you fail and you will leave a tragic failure to unborn generations. This cannot and must not happen.

Thank you. (Applause.)

MR. STEIN: Are there any comments or questions?

Chuck, weren't you Director of the Bureau of Land Management in the Department of the Interior?

MR. STODDARD: I served for three years there, yes.

MR. STEIN: One of the top spots in the Department?

MR. STODDARD: That is right.

MR. STEIN: Well, since you were the head of that, as a former high top government official, I really don't see anything sinister in you taking a position on this case, do you?

MR. STODDARD: No, I didn't--

MR. STEIN: All right. O.K. Thank you.

MR. STODDARD: I just wanted to indicate that we have got a lot of procedures, Murray.

MR. STEIN: Right.

MR. STODDARD: And they have got to be cut through if we are going to make some headway on this.

MR. STEIN: That is right.

MR. STODDARD: We can't let procedures delay us any longer. I had those problems in the Bureau of Land Management. I cut through procedures. I raised a little h-e-l-l out in Oregon and I had a run-in with lumbermen out there over sustained yield management of their lands and it became too hot politically for some people, but I think we have got to go down fighting even if we have to go down.

MR. STEIN: Yes, I know. As you know, I followed that case blow by blow, we both did together.

But the point is when you left the Bureau you didn't cease being and you have kept moving for what you were dealing with.

MR. STODDARD: That is right.

MR. STEIN: And I think you are bringing a lot to the party with your background. So I really don't see anything wrong with former top government officials, such as you are, taking a side in any particular conservation issue and pushing it.

Thank you very much.

MR. STODDARD: Any more questions?

MR. STEIN: May we have Dr. Charles Carson of MECCA?

DR. CHARLES E. CARSON
ASSOCIATE PROFESSOR OF GEOLOGY
WISCONSIN STATE UNIVERSITY
RIVER FALLS, WISCONSIN

DR. CARSON: Mr. Chairman, members of the conference, ladies and gentlemen.

I am a member of the Board of Directors and Associate Professor of Geology, Wisconsin State University in River Falls.

Last year at this conference evidence was presented to show that taconite tailings from the Reserve plant at Silver Bay were damaging the water quality and biota of Lake Superior. Specifically, discoloration and increasing turbidity of the water were cited and increased eutrophication potential from added minerals. In addition, bottom fauna essential in the food chain to trout were shown to be damaged.

Since that time, the PCA of Minnesota, through WPC-15, has recommended turbidity and suspended solids maxima that Reserve says it cannot meet without destroying the tailings density current. Reserve is at present challenging the State standards and has also presented 19 alternate disposal plans to the PCA on April 9, 1970. More recently, the Federal Water Quality Laboratory in Duluth has released reports showing that, contrary to Reserve's contention, tailings are biologically active in concentrations of only 1 milligram per liter over a significant area of the lake. Thus the fact that large portions of the tailings, namely silica, are comparatively inert electrically has in no way insured that they were "inert" biologically. In fact, the relatively stable suspension of fine silica, as compared to natural stream clays, probably only enables the silica to be more effective biologically. And this says nothing of the incomparably more active tailings constituents such as phosphorus. There is no doubt any more that tailings are potentially and actually harmful.

The only questions now remaining are how will Reserve attempt to solve this problem and whether they will. In their April 9 testimony before the PCA, Reserve presented 19 alternate plans, some suggested by consultants, for disposal of tailings in various ways that would partially or wholly restrict them from Lake Superior. Most of the first 11 proposals were concerned with on-land disposal of tailings in the Lax Lake area above Silver Bay or at sites farther inland. Great efforts were made in Reserve's report to show the horrendous difficulties attached to these proposals. They started with a diagrammatic profile of the route from Silver Bay to Babbitt which had the vertical scale exaggerated 50 times over the horizontal, thus making the uplands behind Silver Bay appear to be of mountainous proportions. After this frightening prospect came an estimate of up to $195 million to pay for Lax Lake disposal.

But even more horrible specters were conjured up. It appears that Lax Lake disposal would violate sound conservation. Naturally, with their fine record of environmental concern, Reserve painted a dismal picture of wholesale destruction of, I quote, "prime hunting, fishing, recreation, and resort country, with both seasonal and year-around homes. All would be covered by the tailings basin; Lax Lake itself would cease to exist. Dust from blowing tailings could be expected to affect the region." And worse yet, a "huge tailings basin" would be "poised high above the residences of the Beaver Bay region," constituting a truly dreadful "safety hazard." With relief, Reserve concluded that this straw-man proposal would have to be abandoned.

The first Lax Lake proposal was followed by one suggesting disposal near the mine at Babbitt. For winter operations a huge thaw-shed was envisioned or else electrically heated railroad cars. This proposal, like the first Lax Lake proposal, was regarded as totally untenable and was consequently abandoned. Following this one, numbers 3, 6, 7, 8 and 9 all dealt with one type or other of disposal in Lax Lake and were abandoned for reasons similar to those given in proposal number 1.

Proposal No. 4 suggested disposal by deep pipe into the lake. It presumed that deep water deposition of fines would preclude them ever rising to the surface, a presumption by no means certain. Furthermore, in light of the recent water lab evidence concerning biological activity of tailings, something Reserve ignores, such disposal would be even more questionable. Reserve "abandoned for the present" this idea, but since it is relatively cheap and would mask pollution for some time it is likely they will reconsider.

Proposal No. 5 involves tailings disposal under a "protective curtain" 100 feet deep. The fines then would presumably pass into deep waters underneath this curtain and never mix with the surface waters. Exactly the same criticisms can be made of this proposal as were made of the deep water pipe. In addition, there is little likelihood that the waves of Superior would respect any curtain that is not made of concrete and steel.

Proposals 10 and 11 are similar to the Lax Lake proposals and proposal number 2, and some of the same difficulties were encountered. These were abandoned.

Proposal 12 was similar to the deep water pipe proposal and the same objections can be raised. It was abandoned.

Proposal No. 13 was for a lakeshore tailings pond behind a dike composed of coarse tailings. Excess water would be reprocessed. This idea would keep tailings from the lake, but after attaining some size it is possible that the dike would be "unsightly," according to Reserve, certainly an aspect of their present program which has never concerned them. Also dust blowing over the surface would possibly be a problem. If dust is not a problem with the delta now, why should it be in some future pond? Reserve continues to study this one.

Proposal No. 14 was for a thickened coarse tailings delta. This idea concerns building up the snout of the delta with coarse tailings, protecting this with pilings or rock dikes, then pumping the fines through a pipe into 150 feet of water. This is a variation of the deep water pipe proposal and questionable for precisely the same reasons.

Proposal No. 15 is for construction of an

Dr. C. E. Carson

underwater sand reef for bottom fauna and fish. Reserve claims this would greatly help fishing, and best of all, "No tailings would be seen entering the lake." Hidden effluents are always attractive. They are still effluents, however. The same objections are raised by MECCA to this proposal as were raised to the deep water pipe and similar proposals. Great storms on Lake Superior can have a wave-base reaching the projected depth of 150 feet, and lesser ones may generate rip currents sometimes reaching it, and thus fines would be put in suspension. Reserve is hot for this one; MECCA is not.

Proposal No. 16 is for a small boat harbor and swimming area. Tailings would be used for construction and to make a beach. The prospect of government aid here intrigues Reserve, and they grudgingly admit that such a facility, if it is built, should be controlled and operated by the village of Silver Bay.

Proposal No. 17 is for dry-cobbing of rod mill feed, reducing the discharge of tailings to the lake by 30 percent, but these 30 percent would be deposited on land somewhere--but the remainder, I should say.

No. 18 was for screening ore ahead of the rod mill, and according to Reserve, it would, among other things, permit use of lower water velocities in transporting waterborne solids.

I might point out that these two, 17 and 18, should have been considered a long time ago.

The last proposal, No. 19, covers a broad range of possibilities, or at least finally admits they exist. It is entitled, "By-Product Use of Tailings." One interesting suggestion here is that tailings can be used as filter media in municipal water plants.

In brief, then, Reserve's proposals range from threatening and expensive Rube Goldberg devices, calculated to strike terror into the hearts of their own workers and conservationists, to ideas which would only hide pollution to, finally, a few possibly sound ideas. Some demonstrate, either by their difficulty, such as on-land disposal, initial engineering blunders in first designing Reserve, and others, 17 and 18, subsequent engineering sloth. In other words, a lot of the present trouble could have been avoided long ago had Reserve chosen. So we see, once again, the cost of yesterday's bullheadedness.

Dr. C. E. Carson

There is little doubt that some combination of proposals 13 and 16 through 19 could easily solve Reserve's problem. Regarding 19, some thought ought to be given filtering fines by either draining or forced pumping them down inside the delta. This might be cheapest of all. If they filter, then maybe they will filter themselves. I suggest they consider it, and I won't charge any fee either.

Some of Reserve's suggestions, then, merit consideration and shed a glimmer of hope that at last this company is coming around. However, MECCA will not hold its breath until concrete and solid action is under way. There have been too many tricks pulled before to warrant high hopes now. Still, the world's largest taconite plant and a company accounting for 12 percent of all U. S. iron ore production--10 million tons annually--is certainly capable of significant action if it chooses. And an annual net profit in the neighborhood of $60 million easily eliminates Reserve from the poverty class, even though they sometimes pretend to bankruptcy. If only a little of the genius that goes into the design of such facilities as Reserve and the cautious judgment, and even scheming, that goes into administering them could be put to true social concern, recycling, and environmental efforts, this would be a far better land. It would forever prevent revolutionaries from seeing their mirror-images in certain corporations, and would make it unnecessary for John Blatnik to state that, "Man is going to learn to control his environment if it kills him," (laughter) as such "learning" is now doing. It would do more for building a freer, better society than just about anything, and would materially reduce the premium now placed on sycophantic toadies, which is rapidly killing us all.

Thank you. (Applause.)

MR. STEIN: Thank you, Dr. Carson, for an excellent statement.

Are there any comments or questions?

I do see a glimmer of hope. I really think we are getting closer together. This is great.

DR. CARSON: Thank you.

MR. STEIN: You know, you refer to a glimmer of hope, that is yours, and I really think with the analytical work that your group has done, and hopefully we will be hearing from the other parties, this is very encouraging indeed. Thank you very much.

DR. CARSON: You are welcome.

MR. STEIN: May we have Mrs. Arlene Harvell of the Save Lake Superior Association, Two Harbors, Minnesota.

MRS. ARLENE HARVELL, EXECUTIVE DIRECTOR
SAVE LAKE SUPERIOR ASSOCIATION
TWO HARBORS, MINNESOTA

MRS. HARVELL: I am Mrs. Arlene Harvell and I am currently serving as Executive Director for the Save Lake Superior Association, an organization which is composed of membership in Minnesota, Wisconsin, Michigan, and Canada.

Gentlemen, 11 months ago when the Save Lake Superior Association first addressed this conference we represented 800 members. Today SLSA is 14 months old and we are now speaking for over 2,200 residents of Minnesota, Wisconsin and Michigan. Lake Superior is our environment. Our health and welfare are tied to its future.

On May 14, 1969, as part of our testimony at the initial session of this conference, we presented over 100 letters of personal testimony for the record. If you have taken the time to read even a few of those statements, many of them notarized eyewitness accounts of pollution, you will realize that they are still valid today. Their predominant message was: Yes, we can see that taconite tailings as well as other pollutants are destroying the beauty of Lake Superior. Their predominant plea was for strong enforcement action. It still is.

Currently,we recognize four major priority issues which this conference should be concerned with. They are:

1. The inadequate sewage treatment facilities for communities already established in the Lake Superior Basin as well as for those areas anticipating development.

2. The degradation of Lake Superior through the effects of industrial waste discharges, particularly the current damages being inflicted by taconite tailings.

3. The indiscriminate development of Lake Superior's shoreline areas, including the building and

expansion of powerplant facilities.

4. The despoiling of Lake Superior by the discharge of dirty ballast and sewage wastes from cargo vessels.

In reference to these issues SLSA submits the following recommendations to this conference for their consideration:

1. We encourage the preparation and publication of plans and cost proposals for future sewage treatment facilities to be built in the Lake Superior Basin. Citizens cannot be expected to act intelligently on this priority issue without adequate knowledge of the full scope and cost involved in the long-range plans for the Lake Superior Basin.

2. It is our understanding that the E. I. DuPont deNemours Company has announced plans to build a waste treatment facility at their Barksdale, Wisconsin, plant. A commitment to those plans would be very commendable and we are watching for the construction to begin.

Concerning the pollution of Lake Superior by Reserve Mining Company's E. W. Davis Works at Silver Bay, Minnesota, the Save Lake Superior Association contends that the only effective means of eliminating this pollution is by total on-land deposition of the tailings.

To date, it appears as though Reserve Mining Company's actions, first of hiring former Government administrators who are former members of regulatory agencies which have been and continue to be involved in the taconite tailings issue, and also their action of seeking court appeals to Minnesota's new federally approved water quality standards, can only serve to prolong implementation of pollution control measures. We feel that such actions, rather than serving to "relieve" the concern that over 180,000 citizens of Minnesota expressed last May 13 through 15, these actions have only served to increase the concern about this corporate citizen's intentions.

SLSA must call for an immediate revocation of both the U. S. Army Corps of Engineers permit and the permit issued by the former Minnesota Pollution Control Commission on the following grounds:

a. The tailings are traveling beyond the nine square miles of permit area.

b. The tailings are contributing to, if not a cause of, the discoloration of Lake Superior waters and therein also constitute a public nuisance.

c. There has been sufficient scientific evidence to presume damage to interstate waters.

d. Scientific evidence has shown that the taconite tailings do have a deleterious effect by reducing organisms that are necessary to fish life.

SLSA asks, therefore, that this conference request the U. S. Army Corps of Engineers and the U. S. Bureau of Mines to make a joint analysis of the various on-land disposal methods, sites and economic feasibilities. This study should utilize and compare techniques currently in use at other taconite processing facilities.

3. SLSA would like the consideration of a lake shore zoning concept for the entire Lake Superior Basin. All new development proposed for the Basin would require that the developer submit an environmental impact analysis taking into account both recreational and commercial aspects. This analysis could then be submitted to the proper governing authorities and made available for public scrutiny for a period of six months prior to issuance of

permits to build and/or to operate. All such permits would be subject to automatic revocation in the event that their operation was found to be lowering the quality of Lake Superior significantly.

4. While SLSA approves the intent of regulations restricting wastes from small watercraft, we insist that the same restrictions should be applied to commercial, recreational and Federal vessels alide. A means of eliminating the discharge of pollutant ballast water must be initiated immediately.

The Save Lake Superior Association has recognized these facts:

First, that Lake Superior is worth saving; secondly, that she needs saving; and third, that there is a majority who are in favor of saving her.

We feel that we have provided you, the conferees, with ample support for taking a firm stand on:

Plans for adequate sewage treatment facilities,

For revocation of Reserve Mining Company's permits to dump tailings into Lake Superior,

For total Lake Superior Basin planning to prevent pollution

And for the elimination of ballast water and other wastes from all vessels on Lake Superior.

SLSA, the Save Lake Superior Association, will support you in enforcing the conditions of all permits and in upholding the highest water quality standards for Lake Superior. Gentlemen, the rest is up to you. (Applause.)

MR. STEIN: Thank you, Mrs. Harvell. I particularly want to thank you for calling our attention to some other pollution problems in Lake Superior other than the taconite tailings. (Laughter.)

Are there any other comments or questions?

If not, thank you very much.

May we have Mr. John T. Shiner, Chairman of the Students for Environmental Defense.

By the way, if anyone can't appear at the time I call their name, don't hesitate to speak up. We are not cutting anyone off and you are not going to be irrevocably lost. We will make other arrangements.

Do we have Sister Beverly Raway here?

SISTER RAWAY: The student president will present our statement.

BOB MEYERS, PRESIDENT
STUDENT COUNCIL, DULUTH CATHEDRAL
HIGH SCHOOL, DULUTH, MINNESOTA

MR. MEYERS: Mr. Chairman, distinguished members of this conference and fellow citizens.

My name is Bob Meyers, and as president of the Student Council I speak on behalf of the students of Duluth Cathedral High School.

A matter which concerns us all brings us together today, the future of Lake Superior. As a member of the generation which has a special interest in the future, I am grateful for the opportunity to address you today.

We at Cathedral are concerned about the future of Lake Superior and the results of this conference for several reasons.

First of all, we have been made aware of the relationships which exist between man and his environment and of the dangers which face man if they ignore these relationships. We know what has occurred in other rivers and lakes because of the unthinking misuse of these natural resources. Because we cannot be certain of all the effects of the materials, inert and otherwise, deposited in Lake Superior, we believe it is essential that all other reasonable precautions be taken now to prevent an upset in the ecological balance of the lake. We are learning all too late that it is easier to prevent pollution than to cure it and we hope that this conference will be a step in the right direction.

Secondly, because Lake Superior is part of our backyard, we have often selfishly considered it to belong only to those whose boundaries touch its shores. We can no longer afford to think in these terms. We are not the only beneficiaries of its wealth. Lake Superior is a natural resource which belongs to all of the people of the world, present and future. We who live near the lake bear the responsibilities of preserving it clean and pure for all those who come after us. None of us want to be responsible for the formation of another Lake Erie.

Finally, because we feel it so keenly that we share the responsibility for keeping Lake Superior clean, we at Duluth Cathedral want to offer today our energy and cooperation in any way we can to industry, science and government in whatever way we will be called upon to assist them now or in the future and we hope that these forces will begin to work together for the good of Lake Superior and the entire northern community.

Thank you. (Applause.)

MR. STEIN: Thank you.

Are there any comments or questions?

If not, thank you very much.

Now, before we go on, I would like to make a point about expediting the conference. We would like to have people who are here in live bodies ready to come up when we call on them.

Again I will ask Mrs. Piere to stand up. Will you stand up, Mrs. Piere?

Anyone who wants to talk or make a statement should get in touch with her. She will give me the names and we will call on them. Please be prepared to come up promptly and make your presentation when I call on you.

With that we will stand recessed for 10 minutes.

(RECESS)

MR. STEIN: Let's reconvene.

Is Mr. Shiner available at the present time to speak for SCOPE?

MR. SHINER: Yes, sir.

MR. STEIN: Mr. Shiner, would you go ahead.

JOHN T. SHINER
MEMBER OF GREAT LAKES REGION
STUDENT COUNCIL ON POLLUTION AND ENVIRONMENT
MINNEAPOLIS, MINNESOTA

MR. SHINER: Mr. Chairman, conferees, ladies and gentlemen.

In January of this year Student Council on Pollution and Environment, SCOPE, was formed, with help from the Federal Water Quality Administration, to provide the Department of the Interior contact with student leaders interested in our environment. Students are indeed interested in our environment and for good reasons:

We have high ideals not yet blunted by realities of profit, friendships and narrowmindedness.

We face the consequences of today's misuse of everyone's environment and must somehow strive to protect mankind, an endangered species.

I am here today because Lake Superior is important and threatened. Lake Superior is important because it is a large clean body of freshwater, one-twelfth of all the freshwater in the world, and it is the last unpolluted Great Lake. It is threatened by man in many ways, the most important being U. S. Steel, Duluth-Superior Sewage, and,of course, Reserve Mining.

My comments will center upon Reserve Mining because they alone are fighting with every trick imaginable. They have denied evidence; they have met privately with high government officials; they have obscured any middle ground and polarized public opinion.

They have denied evidence. Consider this Reserve statement on green water:

"We learned that on the infrequent occasions when we saw 'green water' it was, more often that not, located in areas far removed from our tailings discharge point. And close inspection revealed that the source of the 'green water' was not our tailings."

Compare that statement with this by the Federal Water Pollution Control Administration:

"On each visit, areas of green water were always present beginning at the Reserve Mining Company effluent delta and extending down the lake in a southwesterly direction. Continuous masses of 'green' water have been traced with diving operations and photography to just northeast from the mouth of Gooseberry River."

They have met privately with high government officials. Clark Clifford, the former Secretary of Defense, was hired by Reserve Mining Company to intercede on their behalf with the Army Corps of Engineers. A meeting was set and Reserve officials flew to Washington on March 18, 1970.

They have obscured any middle ground and polarized public opinion.

In the presentation Reserve made last May 13 they included the Mayor of Silver Bay, who presented an appeal to the conferees that they not wreck the town.

The Army Corps of Engineers in letters sent to interested parties after the March 18, 1970, meeting requested comments on, and I quote, "potential consequences of a precipitous suspension of Reserve's operations on the economy of the area." In short, they are asking what would happen if Reserve were shut down.

In a WCCO news special titled "Short Cut to a

Ghost Town," the townspeople of Silver Bay expressed their concern that the town would be shut down if any action were taken against Reserve's tailings.

In each of these instances Reserve has chosen to accentuate extremes rather than to seek any real solution. Surely we must all realize that any realistic solution to Reserve's problem will not result in a shutdown of the Silver Bay plant. I do not advocate such a shutdown and I don't know anyone who does.

In allowing the people of Silver Bay--in allowing the people of Silver Bay--to worry about such extremes, Reserve Mining Company must compete with, of all people, Spiro Agnew as one of the great polarizers of our time. (Laughter.)

Anything that man does, in principle, has a harmful effect upon his environment. If he clears a forest for a cornfield he has destroyed a stable complexity and replaced it with a weak simplicity, but a cornfield enables man to multiply and become interested in other things, so we have a balance between a weaker ecosystem and some spare time.

In truth, the situation at Reserve Mining is not as simple, but there is a short cut to help us find a solution. The short cut I am referring to is called excess profits.

Reserve's plant, with a capacity of 9 million tons, was built at a cost of $300 million without a closed water system. The Erie Mining Company, with a lesser capacity of 7-1/2 million tons, was built at a greater cost of $400 million with a closed water system.

While I realize that this is a most simple analysis, I think that it points up the large expense required of all the other taconite processers. Reserve Mining should not continue to profit from degradation of our environment.

The conferees will see at this conference the 19 alternatives presented by Reserve Mining Company. May I suggest the logical utility of adopting criteria to act as guidelines for Reserve? Some criteria which would immediately come to mind might be:

1. Assurance that any dust problem would be contained.

2. That tailings be reclaimable for later use.

3. That the Lax Lake recreation area not be

destroyed, but because Lake Superior is more important than Lax Lake, this area may be modified considerably.

4. That any flocculant or coagulant used must be extensively tested by both the Federal Government and by Reserve for chronic effects on fish and wildlife.

Gentlemen, before stating my conclusions and recommendations, might I suggest that the control of permits, such as those now administered by the Army Corps of Engineers, be instead governed by the Federal Water Quality Administration. Secondly, I would advocate direct legal action by the Federal Water Quality Administration rather than reliance upon other legal departments.

Conclusions:

Reserve has reached the wrong conclusions in the face of painstaking efforts by the Federal Water Quality Administration.

2. Reserve has sought a polarization of attitudes designed to win their battles dishonestly.

3. Reserve has a significant economic advantage over other taconite producers.

Recommendations:

That the conferees continue their sharp interest in protecting Lake Superior and attempt the very difficult transition from interest to action.

2. That the conferees note criteria for alternate means of tailings deposition.

3. That the conferees promote a policy of no profiting while polluting.

To conclude, gentlemen, may I quote Dr. Albert Schweitzer:

"Man has lost the capacity to foresee and forestall. He will end by destroying the earth."

Let's all try to prove him wrong.

Thank you. (Applause.)

MR. STEIN: Thank you. Mr. Shiner, don't run off. I wish most of you would stay up there.

I want to thank you for a very thoughtful statement. I am getting more and more convinced about this generation gap. Do you know who was the great polarizer of my time?

MR. SHINER: Who was that?

MR. STEIN: Admiral Richard Byrd. (Laughter and applause.)

J. T. Shiner

I would like to bring you back to one point which you said, though, and I think this is a fundamental point, not just here, but in all the citizens group relations with their government and with their officials, and that is the notion that something is wrong or something is illegal about any interest group having, quote, a private meeting with top government officials. This is how I spend most of my time, and I suspect the State officials, having private meetings. One, I would like to say, it is not because these meetings are private, and if we ever took the trouble to call the press to tell them about all the meetings we are having, we would wear out our welcome in five minutes and no one would care less. Most of the meetings anyone can come to if they want to come. It is not that they are secret or private. They are generally so either parochial or technical that people are left to their own devices.

And the second point, it seems to me, under our society if anyone asks me as a government official for a private meeting, my door is always open and we keep it open and that is our policy, to keep it open. If we are talking about nonpolarization and we are trying to get together, we have to use all the techniques we can, and one of the time-honored techniques in this country is having meetings with various parties to a controversy and trying to bring them together.

The point is, in a democratic society, fortunately, you can always throw the rascals out and if you don't have enough faith in your public officials to trust them in a private meeting with a special interest group in the field that they are working in, then it seems to me you need new officials, (applause) because if you give that up, if you give that up, you are giving up one of the real cherished privileges of a free society. You and us and everyone is entitled to privacy. This is not like a big brother society where everything you do has to be turned inside out like a piece of bread that we are kneading. You can, if you want privacy, get that privacy. The government will protect your right to that privacy, the Constitution will protect the right to your privacy. This is what makes a free society work. Please don't knock it and go against it. We must have this.

And the reason I am taking so long in saying this to you, if this is the kind of thinking you get, just try to figure out where this is going to lead. There are some things here in working under the Constitution in a free society which are just as important to preserve as cleaning up pollution.

Are there any other comments or questions? If not, thank you very much.

MR. SHINER: Mr. Stein.

MR. STEIN: Yes.

MR. SHINER: I might just try to ad lib--

MR. STEIN: Go ahead.

MR. SHINER: --and tell you why we seem to be so upset about this particular meeting.

There are aspects of the previous boss of the people who have the opportunity to make the decision, the important decisions, being hired and paid by Reserve then to, theoretically, reverse their opinion and present the opinion with some authority to the Army Corps of Engineers in this case. And while it may not be this particular meeting, it does seem that the Army Corps of Engineers do tend to cooperate far better with companies like Reserve Mining than they will ever cooperate with various citizens groups. (Applause.)

MR. STEIN: Again, everyone is entitled to make his own judgment. I don't share that judgment. I have worked with the Army Corps of Engineers, again, for a quarter of a century. I think if you are thinking in terms of conspiracy and secret meetings, you can get to that. However, Mr. Shiner, you can analyze the facts of a particular situation, analyze them very, very well both from your recommendations and your presentation. I recognize that this business of governmental relationships, governmental agencies and rights being in a social field are perhaps a little more complex than even analyzing a physical situation of the pollution or nonpollution of a particular watercourse.

However, I suggest that it might be very fruitful if you did not just take statements or accusations or contentions in this field as they are given, but rather you looked into them very, very carefully. As far as I know, the Army Engineers are pretty responsive to the public will. I don't know if any of their people are here. The Army Engineers, on the other hand, a lot of people have said, have as big a constituency as any governmental agency in the country has and they don't have this constituency without having thorough public hearings, having their ears to the ground and painstakingly doing their homework.

Again I ask you not to make any of these broad value judgments, but look into each case and see this, and perhaps your attitudes or your mind may change.

MR. SHINER: Thank you very much.

MR. STEIN: Thank you. (Applause.)

May we have Martin Hanson. Secretary of the Wisconsin Resources Conservation Council.

MARTIN HANSON, SECRETARY
WISCONSIN RESOURCES CONSERVATION COUNCIL
MELLEN, WISCONSIN

MR. HANSON: Mr. Chairman, my name is Martin Hanson. I am secretary of the Wisconsin Resources Conservation Council, which is an organization of about 40 groups in Wisconsin banded together for the wise use of our natural resources.

I would like to endorse what other speakers have said here rather than repeating it, such as Grant

Merritt and this young student who was here prior to my coming up here.

I think the point is that Reserve Mining does pollute Lake Superior and that on-land disposal is possible. All of you gentlemen sitting at this table in one way or another are government pollution control and that is the name of your agencies, so do what it says, just give them an order for on-land disposal.

Reserve Mining saves $24,000 a day by dumping their tailings into the lake. Forty cents a ton is what the Bureau of Mines estimated their costs were per ton of on-land disposal and it is over sixty tons a day, that is $24,000 a day. It buys a lot of lawyers and a lot of propaganda to defeat the public interest.

I would like to say that in the big picture of conservation of Earth Day here a week ago that all of us are going to have to give up something. On Earth Day I gave up smoking. It is real tough.

Here in the United States we are 6 percent of the population and we consume anywhere from 30 to 60 percent of the natural resources consumed in the whole world.

I would like to make a suggestion that all of you gentlemen here at this table go down to where the scrap metal is loaded on the boats here at Duluth Harbor. There you will find that the scrap automobiles and scrap metal, there is three electric cranes that load the scrap metal on the boats, it takes 30 days. Then that boat goes all the way through the St. Lawrence Seaway, through the Panama Canal, goes to Japan. In Japan there are between 500 and 600 men that they put in that boat to unload it by hand. It takes 30 days. Then the Japanese reuse that metal, ship it back here and compete and undersell our steel companies. That we continually have to tear down more of our hills, surface mine more of our land and throw the waste material into the lake and can't reuse our steel is ridiculous. If we impose more restrictions on our mining companies to leave the land in a neat and orderly condition, not pollute the waters, and these types of things, then we will start toward the reuse and recycling of our natural resources which we are liable to run out of.

So I think it would be excellent if you stop Reserve Mining from dumping this taconite tailings into the lake. I think in the big picture of conservation we have to do those things and we have to do it very quickly or we are all going to be in serious trouble.

Thank you. (Applause.)

MR. STEIN: Any comment or question?

If not, thank you very much, Mr. Hanson.

Do we have the Students for Environmental Defense? You have a taconite study group and a Duluth, Minnesota, group. Are the representatives here to speak for those groups?

BRENT HAGLUND
STUDENTS FOR ENVIRONMENTAL DEFENSE
UNIVERSITY OF MINNESOTA
DULUTH, MINNESOTA

MR. HAGLUND: My name is Brent Haglund and I represent the Students for Environmental Defense, University of Minnesota at Duluth.

Mr. Chairman, conferees, and citizens concerned about the future of our environment.

We would like to recognize first that Lake Superior is this area's greatest natural resource. Any practice detrimental to the quality of this lake must be

B. Haglund

stopped and cannot be condoned.

The Students for Environmental Defense of the University of Minnesota, Duluth, believe that the dumping of taconite tailings by Reserve Mining Company is having a deleterious effect upon the esthetic quality and biological functioning of the lake. Further it should be recognized by all present that the tailings clearly travel outside the nine-square-mile area reserved by the Army Corps of Engineers for that purpose.

The company should realize its corporate responsibilities to the citizens of the entire Lake Superior region. We realize the economic impact of the company on this region. Many of us have lived here all of our lives. But Reserve has a responsibility to supply more than jobs. It must adopt practices consistent and harmonious with a quality environment, something it has not done to date.

We do feel that the long-term recreational, industrial, and all other public uses of the lake would be best served by the revocation of Reserve Mining's permit to dump taconite tailings into the lake until that time that they may adapt environmentally suitable methods of tailings disposal.

Furthermore, we recognize that no one has the right to pollute the lake in any manner. We must prevent damage to the lake now. We must not lower our criteria of quality water to achieve a short-run economic benefit by allowing Reserve or any others to continue to dump and to pollute. Therefore, our stand is that we would like to urge the revocation of Reserve Mining's permit until suitable and alternative methods of disposal of production wastes have been found.

Thank you very much. (Applause.)

MR. STEIN: Thank you.

Any comments or questions?

If not, thank you very much.

Is there anyone else from the Students for Environmental Defense?

Would you come up, please.

MARY THERESA DOWNING
STUDENTS FOR ENVIRONMENTAL DEFENSE
UNIVERSITY OF MINNESOTA
MINNEAPOLIS, MINNESOTA

MISS DOWNING: My name is Mary Theresa Downing and I am speaking for the Students for Environmental Defense on the Minneapolis Campus. This is a statement that was drafted by that group.

Lake Superior, unlike Reserve Mining Company, is a natural resource, a part of our environment, and thus is beyond any price tag. Reserve Mining Company, however, contributes $31.5 million every year to the economy of the State, not to mention untold millions of dollars every year in profits to its two stockholders, Armco Steel of Ohio and Republic Steel of New Jersey. Gentlemen, we must break with the tradition that "money talks." We should realize that money does not make the world go round, rather trees and clean water and fish and animals, including man, are what make the world go round.

Our environment is not a passive entity which we can mold and change at will. Sometimes we get the impression that man has mastered his environment,for we can fly about the country any time we like. We can even walk on the moon. But we cannot stop lung cancer and emphysema caused by smog. We can't change the fact that mother's milk has unsafe levels of DDT.

At this conference you are given what, in comparison, is a relatively simple task--to stop Reserve Mining's insult to Mother Nature. In your efforts please consider the widespread effects of a general degradation of Lake Superior, and keep in mind the now irreversible damage that has been done to Lake Erie.

Thank you.

MR. STEIN: Thank you, Miss Downing. (Applause.)

MISS DOWNING: I would also like to read a statement from a group at the University which I am a member of, Minnesota Rovers, a camping group.

This is a group of 160 outdoorsmen at the University of Minnesota, the Minneapolis Campus, and we would like to take this opportunity to express our concern for the future of Lake Superior. We regard the continuing process of dumping taconite tailings into the lake as a clear and present danger to Lake Superior's present relatively unpolluted status. The time is long past when such forms of active pollution could be regarded as spurious.

We urge that Reserve Mining be asked to otherwise dispose of its taconite remains. Certainly the ideal solution is to return the unused portion of the taconite ore to the original mining site. If this is found to be prohibitively expensive, certainly the present state of the art of modern technology would ensure that other alternatives could be found that are less disruptive of the environment.

Thank you. (Applause.)

MR. STEIN: Thank you, Miss Downing.

May we have Dr. Gale R. Gleason, Chairman of the Natural Sciences Division, Lake Superior State College.

Now, this is all I have of the citizens group. If I have missed any, while Dr. Gleason is coming up--is he here?

DR. GLEASON: Right here.

MR. STEIN: Yes. While Dr.Gleason is coming up, if anyone other than industry or governmental officials wishes to talk now, be sure to get in touch with Mrs. Piere.

Dr. Gleason.

DR. GALE R. GLEASON, CHAIRMAN
DIVISION OF NATURAL SCIENCES
LAKE SUPERIOR STATE COLLEGE
SAULT SAINTE MARIE, MICHIGAN

DR. GLEASON: Mr. Chairman, conferees and guests.

I didn't know I was walking into such a hornet's nest at the other end of the lake. I am from Sault Sainte Marie and things are fairly peaceful.

I am genuinely concerned as a citizen and have been associated with water quality in trying to establish standards since 1952. My friend Carlos Fetterolf and I remember long evenings with the Midwest Benthological Society. Such men as Ken Mackenthun and others certainly were the forerunners of the criteria that we are trying to accept today.

I think basically the criteria that was proposed and I hope accepted by the executive committee will be that which is used for Lake Superior; basically it is sound. I am concerned, however, over a couple of aspects that may be or fall within the jurisdiction of the various States which are responsible for enforcing the criteria. As a scientist I am aware that the method of sampling and of gathering of data is far more important than the results obtained, that unless the method of sampling and obtaining the basic information is accurate we are going to find such situations occurring as recently appeared in Michigan with the mercury problem.

I do not believe from what I can glean so far that our method of sampling and miantaining a vigilance on Lake Superior is adequate. The water intake station at Sault Sainte Marie is located in such a position as to receive portions of the effluent from Algoma Steel and various streams which drain through about one-third of the populous centers which are receiving partial treatment in Sault Sainte Marie, Ontario. Furthermore, at this station, the intake is directly in the canal through which the ships pass over less than 18 feet from the intake and the recycling occurrence and the disturbance of the sediments is a constant factor in this particular station. I am hoping that this conference will look into a more realistic surveillance practice.

I might propose at this time that we give careful consideration to a Federal agency which has been established to protect our harbors, our rivers and our lakes--yes, in fact as far as pollution is concerned they have this basic charge already. I appeared at the headquarters of the Ninth District of the U. S. Coast Guard three weeks ago to talk with a man in charge of the district which covers the Great Lakes to explore with them the possibility of establishing with the United States Coast Guard a monitoring program. Subsequently I talked to the directors of the Marine Science Technology Training Program at Governor's Island to find out what criteria they were using in their presentation to determine the enforcement necessary on a recent edict they received as far as oil pollution is concerned. I could not get the complete information. However, I found out that the United States Coast Guard is in fact establishing within their organization a pilot study program to see whether or not the feasibility of extending their services to cover all the Great Lakes is possible.

I am genuinely concerned that unless we call upon an agency such as the United States Coast Guard that we are going to see a bureaucracy created to monitor these lakes at an additional expenditure to the taxpayer which would be prohibitive. These are the logical people to collect these samples, to have trained personnel at every station, and to report these to the respective State agencies for evaluation and submission to the Federal Water Quality Administration.

I do not at this point want to exonerate also the Army Corps of Engineers which has fallen under fire for the last two and a half hours. I am genuinely concerned with the emptying of ballasts in the area of Sault Sainte Marie. Much of the ballast that is picked up or transported as ballast comes from the highly polluted situations in Cleveland, Detroit, Toledo, and possibly from foreign ports carrying all sorts of--well, I won't go into that. (Laughter.)

These ballasts are emptied within the vicinity of Sault Sainte Marie and as soon as the port has been cleared and the ships are in Whitefish Bay, many of the ballasts carrying the domestic sewage accumulated aboard ship are also emptied. I do not see why the Corps of

Engineers in the 20-some minutes it takes to pass a ship through the locks at Sault Sainte Marie cannot provide a mechanism by which these ships and their companies can empty their ballasts and refuel with clean water and travel on up to a station like Sault Sainte Marie. (Applause.)

This could be on a cost basis and possibly an 80 percent poverty stricken area such as Sault Sainte Marie, Michigan, could afford to build the tertiary treatment which the Federal Water Pollution Control Administration, through the Michigan Water Resource Commission, has passed on to the city of Sault Sainte Marie. We might be able to get the station that we so badly need for our phosphorus removal.

In conclusion, I am satisfied with the criteria. I am hoping that the conferees can recommend that the monitoring methods of protecting Lake Superior be placed on the shoulders of an agency that is capable of responding to this and handling it without an additional cost to the taxpayers and that the Army Corps of Engineers assume the real responsibility that they have to protect our water resources.

Thank you. (Applause.)

MR. STEIN: Thank you, Dr. Gleason.

Any comments or questions?

If not, thank you very much.

Mr. Dave Zemtner, president-elect of the Minnesota Division of the Izaak Walton League of America.

DAVID ZEMTNER, PRESIDENT-ELECT
IZAAK WALTON LEAGUE OF AMERICA
MINNESOTA DIVISION, DULUTH, MINNESOTA

MR. ZEMTNER: Mr. Chairman, conferees.

My name is Dave Zemtner. I am President-Elect of the Minnesota Division of the Izaak Walton League of America. I live in Duluth.

The Izaak Walton League endorsed the principle of this pollution conference by presenting on behalf of the Duluth Chapter and the Minnesota Division a position paper at the onset. I would like today to take two or three minutes to reflect on the progress since our original position paper and to share with you some of my concerns and that of the State Division.

D. Zemtner

At the time, in our position paper we indicated strong endorsement of and support for public agencies such as the Minnesota PCA and the Federal people elected and appointed in providing a better environment for the citizens of this State and the region. We indicated that as a lay organization we were concerned with the following sources of Lake Superior pollution: ballast, just referred to, oil, thermal, nuclear, municipal, other industrial as well as the taconite situation.

We indicated that as a lay organization it would be difficult for us to articulate and get involved in a dialogue concerning some highly technical areas, so we were willing to follow the proceedings, support the public agencies and see what the circumstances would provide.

We recognize that the Reserve Mining situation presented a special problem because of the fact that the State of Minnesota endorsed the concept originally, as did several conservation organizations, when Reserve was given its original permit, including the Izaak Walton League. We indicated that this special problem should be worked out under a harmonious environment. However, as

I stand before you this morning, I am now getting to the point of dismay that I referred to in my initial comments.

It would appear that the people representing Reserve Mining Company have taken the position that the burden of proof must lie upon the public agencies and the people of the region before any action need be taken. I say this cannot be so. The burden of proof has to be on Reserve Mining Company that they in fact are not harming the ecosystem of Lake Superior.

Secondly, I am dismayed by the emphasis on public relations, newspaper ads, and statements of this type as opposed to good hard factual methods of alleviating the present method of disposition. The language of this conference indicated, and I quote, "the fact that the tailings are deleterious to the life of Lake Superior." Therefore, I believe we must move into an area of an alternate method of disposal and preferably an on-site disposal.

Initially when talking with people representing Reserve there was strong conversation that even the green water phenomena was not really relative or related to the taconite tailings. Then the fact that the tailings were dispersed or the fines were dispersed into the interstate area was contested. As a layman I believe it has been proven beyond a reasonable doubt that the tailings do go beyond the permit limit and into the interstate situation.

Thirdly, people representing the company have alleged that the sand is inert, does not go into solution. I believe as a layman from what I have listened to that there is substantial doubt to that.

This pretty much sums up my points to be made this morning. I will close as follows:

We need evolution, not revolution. We need a change based on positive action, positive action that will work out in the long-term benefit of this particular industry being able to maintain itself as a viable part of our area. To further drag our feet and resist change will only ultimately increase the danger of a precipitous action that could economically be a disaster to the very people that are trying to protect their industrial interest.

Finally, I would like to point out that the

Izaak Walton League very sincerely appreciates the work of the conferees, the sincerity of the conferees, the work being done by our own PCA group. However, in this respect I might point out that, with due respect to the problems that you have, we can't continue to be sideline observers too many more months.

Thank you very much. (Applause.)

MR. STEIN: Thank you, Mr. Zemtner.

Minnesota not only has provided able presidents of the Minnesota Division such as yourself, but the national president of the Izaak Walton League also comes from Minnesota. I wish you would give my regards to Ray Haik when you see him.

MR. ZEMTNER: I shall surely do that.

MR. STEIN: Now, there is something you said, and I don't want you to go away from here with a misunderstanding. For this I might quote Oliver Wendell Holmes when he said, "Any bright student can tell me what the law ought to be, but it takes a real expert to say what the law is."

Now, unfortunately, whatever you think the law ought to be, the present law is--and I think Reserve knows it as well as we do--that the burden of proof does rest on the public officials to prove there is pollution. Whether you think it should be that way or not, that is the law we are operating under and that is what we are proceeding on.

We do have amendments proposed by the Administration to strengthen the enforcement procedures and come up with effluent standards which would ameliorate that somewhat. It is a question if you don't think that the present provision of the law provides adequate protection, you should possibly follow the new Administration proposals of strengthening the Federal law and see if you like them. But I just have to tell you existing law places the burden of proof on us to prove pollution.

Thank you. (Applause.)

May we have Glen Nelson?

GLEN NELSON

GOGEBIC COMMUNITY COLLEGE

IRONWOOD, MICHIGAN

MR. NELSON: My name is Glen Nelson. I am from Gogebic Community College. I see Dr. Gleason up here. If you look at this map that I have been looking at all morning while everybody else was speaking, it shows you that Michigan has the largest hunk of water up there.

Well, anyway, as I say, if you look at the map on the wall, it is divided into sections and Michigan has the largest section. In other words, if we judge what is going on by those lines or those fences or whatever you want to call them, Minnesota has already polluted their share of the water.

(Laughter.) The other half belongs to Michigan. (Applause.)

But whoever drew that map must have been wrong, because that lake doesn't belong to Michigan, doesn't belong to Wisconsin, Canada or Minnesota. It belongs to the people who live around it, who enjoy this lake. The problem is not only Reserve Mining, it is also people, it is sewage problems. The whole lake is one big problem, but it is a minor problem because it isn't really polluted. We have the chance to stop this pollution as individuals by working at it.

They say it can't be done. I just came up here to say that if Reserve Mining Company would like to see something that can be done, they can go to White Pine, Michigan. White Pine Copper Company has spent $13 million for pollution control so far and by 1980 they will have spent $39 million in pollution controls. They are not afraid to spend their money on pollution controls. If Reserve Mining would like to see a nice project, I advise them to go to White Pine and look. It can be done. It can be done. (Applause.)

That is all I have to say.

MR. STEIN: Thank you. (Applause.)

Are there any comments or questions?

Are there any other nonindustry or nongovernmental people who wish to speak now?

If not, we will recess for lunch and let's try to get back about 1:35.

(NOON RECESS)

AFTERNOON SESSION

WEDNESDAY, APRIL 29, 1970

(1:35 o'clock)

MR. STEIN: Let's reconvene.

At this point we would like to call on Mr. Purdy.

MR. PURDY: Thank you, Mr. Chairman.

Representative Hellman from the Michigan House of Representatives, representing a district that comprises the counties along the western shoreline of the Michigan upper peninsula and the Keweenaw peninsula, is here today and would like to make a statement and I would be very pleased to introduce him to the conferees and the audience here today.

THE HONORABLE RUSSELL HELLMAN
STATE REPRESENTATIVE
MICHIGAN HOUSE OF REPRESENTATIVES
DOLLAR BAY, MICHIGAN

MR. HELLMAN: Thank you, Mr. Purdy. Ladies and gentlemen.

It is indeed a privilege to be given the opportunity to testify at the reconvened conference on pollution of the interstate Lake Superior and its tributary basin.

My major role, however, is that of a monitor. As the Representative in the Michigan Legislature from the 110th District, which has more than 150 miles on Lake Superior, and as Chairman of the Budget for the Michigan Water Resources Commission, and as a member of the Appropriations Committee for Michigan, I must protect the services given by the Michigan Water Resources Commission.

I must protect also the taxpayer's dollar to see that it is spent in a meaningful way.

In the short time I have been at this conference I have noted the absence of Canada in any official participation in this conference. I feel in order for this conference or any conference which affects Lake Superior to have a meaningful purpose, it would require that Canada be invited to participate. If we do not do this, perhaps we could be feeding pollution into one end faster than we could clean it out of the other, and this definitely would be a waste of taxpayer's money, not only for the State of Michigan but for the other two States who are participating here and the Federal Government as well.

I, therefore, charge you people today with the responsibility of providing not only lip service to your dreams but meaningful and profitable results.

MR. STEIN: Thank you, Representative Hellman.

Let me make one remark on that and you can stay up there if you want to answer or if you have further response.

We keep pointing to our Canadian brothers and are in constant touch with them. I think we have to just recognize, though, on the Great Lakes, on the basis of population and industry, 90 percent of the material going into the Great Lakes comes from the American side, not the Canadian side. If we clean up our side, I think those lakes are going to be in good shape.

MR. HELLMAN: Are you saying this to me? Are you addressing this to me, Mr. Chairman?

MR. STEIN: No. You can make any statement you want now. But the point is, sure, we have to clean up all sources. Certainly our jurisdiction under the Federal law runs to the American side. But on the American side we have 90 percent of the load.

MR. HELLMAN: My answer to that, Mr. Chairman, would be that you can't be 10 percent pregnant. (Laughter and applause.)

MR. STEIN: No, but you can be 90 percent pregnant and if you divide 90 by that 10 you have 9 and you have given birth. (Laughter.)

FROM THE AUDIENCE: A point of information, Mr. Chairman.

MR. STEIN: We will take no questions from the audience. You can see Mrs. Piere if you want to deliver a statement.

May we have Mr. Brommer from the AFL-CIO.

BERNARD L. BROMMER
CONSERVATION COMMITTEE
DULUTH CENTRAL LABOR BODY, AFL-CIO
DULUTH, MINNESOTA

MR. BROMMER: My name is Bernard Brommer. I represent the Conservation Committee of the Duluth Central Labor Body, Minneapolis AFL-CIO.

Chairman Stein, conferees, ladies and gentlemen.

Over the past weekend organized labor held a pollution conference in Duluth. One of the most significant actions at that conference was an action taken by the International Longshoremen of America, Duluth-Superior Ports. They announced at that conference that they will no longer unload ships coming into the Duluth-Superior Port that do not have valid papers saying where they disposed of their ballast water, and if they have no papers they will assume that the water was unloaded in Lake Superior and they will refuse to unload those ships. (Applause.)

Organized labor has attempted for the past 15 years to get legislation on the books to prevent the pumping of solid wastes in Lake Superior. Lake Superior being an international body of water, we do not have any legislation in Minnesota; we do not have legislation on the Federal level; we do not have legislation on the international level.

Organized labor has determined that it is going to start including environmental issues in its labor contracts. (Applause.)

Organized labor has now entered the fight against pollution and will lend itself totally to the problem as it has to all the other issues that it has undertaken in the past.

We have had a lot of talk about the economics of pollution. Organized labor in Minnesota will no longer tolerate the threat to the jobs of its workers in this State. If we are going to talk about economics, I think that organized labor in the State of Minnesota is going to have something to say about that.

Thank you very much. (Applause.)

MR. STEIN: Are there any questions?

If not, thank you very much.

Mr. Davidson, Northern Environmental Council, Wisconsin.

DONALD DAVIDSON
NORTHERN ENVIRONMENTAL COUNCIL
DULUTH, MINNESOTA

MR. DAVIDSON: My name is Donald Davidson. I represent the Northern Environmental Council. I am very happy to be able to come and talk to you this morning relative to the problem of red clay along the south shore of Lake Superior and I come here to state actions that have been taken concerning erosion and sedimentation control in Wisconsin.

All of Wisconsin's south shore counties have been organized as soil and water conservation districts since before 1950 and have been carrying on programs of erosion and sedimentation control since that time. All of these counties have red clay soils. Involved are Douglas, Ashland, Bayfield, and Iron Counties. These soil and water conservation districts have been staffed by the Soil Conservation Service, United States Department of Agriculture, and technical help has been available to landowners for soil and water conservation problems.

The Red Clay Interagency Committee has been concerned with studies to determine the cause of sedimentation in lakes and streams since 1955. The committee published a report in 1967 which contained recommendations which, if followed and implemented on the land, would greatly reduce soil erosion and sedimentation of streams and lakes. The committee involved the following State and local agencies: College of Agriculture, University of Wisconsin; U. S. Soil Conservation Service; Department of Natural Resources, Division of Conservation; Department of Transportation, Division of Highways; Bureau of

Indian Affairs, U. S. Department of the Interior; University Extension Service; Ashland Agricultural Experiment Station; and U. S. Forest Service.

Cost sharing practices have been utilized by farmers under the Agricultural Conservation Program as a means of getting more soil conservation on the land in the counties along the south shore of Lake Superior. Of particular importance and widely used has been the practice of establishing and reestablishing permanent vegetative cover for protection from erosion.

In 1968 an inventory of Erosion on Wisconsin Roadsides was made by many agencies and a report was published detailing the problem in 1969. The four red clay counties along the south shore of Lake Superior were involved, and the inventory information concerning these is available in the Soil Conservation Service offices in Superior and Ashland. The Soil and Water Conservation Districts are promoting action by individual townships, villages, and counties to tackle the problem.

A number of projects involving gully control, road bank stabilization, and stream bank stabilization are in the 1970 Annual Plan of Operations of Headwaters

Pri-Ru-Ta Resource Conservation and Development Project for the Lake Superior counties. The Pri-Ru-Ta Resource Conservation and Development Project is cosponsored by the Soil and Water Conservation Districts and the County Board of Supervisors in the ten northwestern Wisconsin counties. Means are being explored to get such projects done.

Thank you. (Applause.)

MR. STEIN: Are there any comments or questions?

If not, thank you very much.

Do we have any other nonindustrial or nongovernmental participants?

If not, we will call on Mr. Mayo, our Regional Director.

Mr. Mayo.

FRANCIS T. MAYO, REGIONAL DIRECTOR
GREAT LAKES REGION, FEDERAL WATER QUALITY ADMINISTRATION, CHICAGO, ILLINOIS

MR. MAYO: Mr. Chairman, fellow conferees, ladies and gentlemen.

F. T. Mayo

The Lake Superior conferees are here to review the existing situation and the progress that has been made to abate pollution in the basin on conformance with the conference recommendations. What we learn here will lay a basis for future actions by all parties concerned.

A review of the testimony given last May clearly shows the quality of water in Lake Superior surpasses that of virtually all other major lakes in the United States. Everyone agrees the lake is in excellent shape.

However, three points must be reemphasized. First, there is no reason to believe Lake Superior is in some peculiar way immune to the forces of eutrophication. Failure to take all appropriate anti-eutrophication actions will lead eventually to a less desirable Lake Superior. Second, it should also be noted that the character Lake Superior is permitted to acquire will have a great impact on the success of protecting or restoring the Great Lakes downstream. Third, because the self-purging rate in Lake Superior is in excess of 500 years, the lake acts as a trap such that any persistent pollutant will tend to accumulate. This means that if high pollution levels are reached, for all practical purposes they will remain forever.

The conferees are confronted with a unique situation in this conference. In other enforcement conferences we are usually faced with restoring a polluted body of water to a usable condition. The unique position on Lake Superior is that we are dealing with an exceptionally clean body of water and we are taking steps to preserve the lake in its present condition.

There are existing areas of degraded water quality in the lake and in the tributary streams. The conferees were cognizant of the unique character of the lake and the existing problem areas when they formulated the conference conclusions and recommendations.

Final action on some recommendations is still pending. One of the purposes of this session is to review appropriate information and to continue our strong efforts to protect Lake Superior in its unique state.

One of the major recommendations we will be considering is that dealing with the proposed water quality criteria for the lake. The Lake Superior Water Quality Technical Committee will present us a detailed report of their recommendations on that subject.

A great deal of testimony has been given in the past sessions of the conference on the discharge of taconite tailings from Reserve Mining Company. Secretary of the Interior Walter J. Hickel gave special attention to that matter when he transmitted the Summary of Conference to the Minnesota Pollution Control Agency. He stated, "...I recommend that a working copy of the progress report be readied by April 1, 1970, and that the final progress report be prepared as recommended '...within six months of the date of issuance of the Summary of Conference by the Secretary of the Interior.'"

The conferees, I am sure, will be hearing more on the actions taken by Reserve Mining Company and actions that are planned to be taken by Reserve Mining Company to protect Lake Superior from any adverse effects.

Certain of the Lake Superior enforcement conference recommendations require reporting of actions taken by the States and the Federal Water Quality Administration towards compliance with the recommendations. Specifically, the Federal Water Quality Administration has reports on Recommendation 1 dealing with the Lake

Superior Water Quality Technical Committee and Recommendation 2 dealing with the effects of taconite tailings discharged to Lake Superior. Other items to be reported by the Federal Water Quality Administration deal with new Federal legislation concerning waste from watercraft and status of pollution abatement progress at Federal facilities. Due to the significance of other items of business, the latter two statements will be distributed to the conferees and entered into the record as if read. We will, of course, respond to any questions the conferees have on these statements.

Mr. Carlos Fetterolf, of the Michigan Water Resources Commission, will present the Lake Superior Water Quality Technical Committee report.

Dr. Donald I. Mount, Director of the National Water Quality Laboratory, will present the results of studies completed by his laboratory related to the effect of taconite tailings on Lake Superior.

Mr. Chairman, if there are no questions, we can proceed with other of the Federal presentations.

MR. STEIN: If there are none, why don't you call Mr. Fetterolf.

MR. MAYO: All right. Mr. Carlos Fetterolf will present the report of the Water Quality Technical Committee.

CARLOS FETTEROLF, SUPERVISOR, WATER
QUALITY APPRAISAL, WATER RESOURCES COMMISSION
BUREAU OF WATER MANAGEMENT, MICHIGAN DEPARTMENT
OF NATURAL RESOURCES, LANSING, MICHIGAN

MR. FETTEROLF: Chairman Stein, conferees, ladies and gentlemen.

I am Carlos Fetterolf, an aquatic biologist on the staff of the Michigan Water Resources Commission. I am supervisor of Water Quality Appraisal for the Bureau of Water Management, Michigan Department of Natural Resources.

I am one of Michigan's two representatives on the Lake Superior Water Quality Technical Committee. The Federal Water Quality Administration asked me to present the Committee's report to this meeting.

At the executive session of the Lake Superior enforcement conference held September 30, 1969, at Duluth, Minnesota, the conferees reached a number of conclusions and recommendations after appraising water pollution in the Lake Superior Basin. They agreed the water quality in Lake Superior is generally unequalled anywhere in the world and that steps should be taken to protect that quality for future generations.

Recommendation Number 1 concerned itself specifically with the development of appropriate water quality criteria for the lake. That recommendation states:

> "It is recommended that a technical committee to evaluate water quality criteria for Lake Superior be formed of the conferees and such representatives as they may designate, within two weeks of the executive session. The purpose of the committee is to develop particular water quality criteria as guidelines for modification of the Federal-State water quality standards. The provision of the necessary secretarial assistance to the committee will be the responsibility of the Federal conferee. The committee may coordinate its activities with other committees or agencies, or engage consultants, as it determines appropriate. At the next session of the conference, the

committee will report to the conferees on recommendations agreed upon for changing or modifying existing water quality criteria to reflect desired quality conditions in Lake Superior."

The conferees designated the following to represent them on the Lake Superior Water Quality Technical Committee:

Dale S. Bryson, Federal Water Quality Administration (Chairman)

Glen D. Pratt, Federal Water Quality Administration (Replaced Frank E. Hall)

Carlos M. Fetterolf, Michigan Water Resources Commission

Francis B. Frost, Michigan Water Resources Commission

Lyle H. Smith, Minnesota Pollution Control Agency

Clarence A. Johannes, Minnesota Pollution Control Agency

Lloyd A. Lueschow, Wisconsin Department of Natural Resources

Jerome R. McKersie, Wisconsin Department of Natural Resources

Mr. Lou Breimhurst of the FWQA Minneapolis office acted as secretary to the Committee.

Representatives of the Canadian National Government and the Province of Ontario were invited to the meetings and participated as observers.

This report of the Lake Superior Water Quality Technical Committee contains recommendations based on information from published material, testimony of experts, unpublished data from ongoing studies, information presented at the Lake Superior enforcement conference and from the background and experience of the Committee members.

A great deal of technical background information pertinent to the establishment of water quality criteria was discussed by the Committee in their deliberations. The Committee felt it was not appropriate to summarize in this report the basic philosophy concerning water quality criteria as related to the various water uses, as this is available in the National Technical Advisory Committee's publication entitled "Water Quality

Criteria."

The Committee felt there was insufficient information on many parameters to adequately delineate the existing quality of the open waters of Lake Superior. This lack affected some of the Committee's recommendations.

The intent of the Committee was to identify criteria sufficiently sensitive to signal small changes indicative of potential degradation of the existing open water quality in Lake Superior. We recognized that a distinction must be made between inshore and open lake waters. Inshore waters were defined as areas affected by tributary stream plumes, shore erosion, thermal bars, or bottom sediments resuspended by wave action. It was recognized that inshore waters would not be static but would change with varying climatological conditions. Waters not defined as inshore waters or mixing zones would be considered as open waters and should reflect the general quality of the lake.

Relative to present water quality standards.

Water quality standards have been adopted for Lake Superior by the Lake Superior States and approved by the Department of the Interior as required under the provisions of the Water Quality Act of 1965. Michigan's standards for temperature were excepted from approval. The States assigned their highest water use categories to Lake Superior, namely, public water supply, whole-body contact recreation and cold water fishery and included non-degradation clauses. Hence, the water quality standards for Lake Superior are the most restrictive adopted by the States of Michigan, Minnesota and Wisconsin and are among the most stringent standards nationally. The criteria adopted were established using the best available information at that time.

A problem inherent in interpretation of water quality standards occurs where numerical values for a certain parameter are assigned under one water use and not assigned under another. For example, a State may classify a body of water for public water supply and cold water fishery. The zinc criteria as established in the public water supply category would be 5 milligrams per liter maximum allowable concentration in conformance with the U. S. Public Health Service Drinking Water Standards. Yet such a concentration of zinc would be fatal to most aquatic life inhabiting that water body. Therefore, should the State not establish a numerical value for zinc in the cold water fishery classification, it may appear that a concentration of 5 milligrams per liter of zinc would be allowed in those waters. This type of conflict is evident in waters that have a multiple use classification.

The existing water quality standards for Lake Superior were designed to protect the waters near the shore of the lake. If these waters are fully protected from adverse quality effects, the open waters of Lake Superior, or the general quality of the lake will not be degraded.

Water quality guidelines.

Before truly appropriate water quality criteria can be established for a body of water the existing quality must be fully assessed. This assessment permits determination of areas of the lake in which concentrations of certain parameters approach undesirable limits and establishes a baseline quality from which to measure future changes.

The waters of Lake Superior are among the least studied of any of the Great Lakes. Some data have been gathered, principally in near-shore areas, over the years by miscellaneous governmental agencies and universities. However, comprehensive data on the open lake are not available.

The Committee gathered Lake Superior water quality information from the United States and Canada and used these data to assess the existing quality. The Committee also gathered as much information as was available on recently completed and ongoing research concerning criteria for waters similar to Lake Superior. FWQA's National Water Quality Laboratory at Duluth, Minnesota, furnished the bulk of these data. Discussions with personnel at that laboratory proved invaluable throughout the Committee's deliberations.

The Water Quality Act of 1965 provided that after the initial setting of standards periodic review and revision would be required to take into account changing technology and advances in knowledge of water quality requirements. Ultimately, truly appropriate water quality criteria will be developed for specific bodies of water.

C. Fetterolf

The Committee agreed that although the existing water quality standards on Lake Superior were very restrictive, some were not truly appropriate because they were drafted for all high quality waters of the States, not specifically for the open waters of Lake Superior. Because data were not available to completely assess existing quality in the lake and because the existing standards include non-degradation clauses, the Committee concluded it was not appropriate to recommend new water quality criteria for establishment as standards for the open waters at this time. The Committee did feel that existing water quality data were sufficient to permit recommendation of adoption of water quality criteria guidelines. These guidelines will permit monitoring of small changes which may signal potential degradation of existing open water quality in Lake Superior. They will serve as an administrative instrument to the State and Federal regulatory agencies in the consideration of wastewater discharges and cultural activities that affect Lake Superior. These guidelines should be revised as additional background data become available. At some future time the States of Michigan, Minnesota and Wisconsin should consider these guidelines when revising their water quality standards for Lake Superior in accordance with the Federal Water Quality Act of 1965.

The FWQA's report, "An Appraisal of Water Pollution in the Lake Superior Basin," as prepared for the use of the conferees at the Lake Superior enforcement conference included details of proposed water quality criteria. Appendix C to that report contained the rationale for the proposed criteria. These criteria and rationale were used as a base for the discussion of guidelines by the Committee.

Table 1 presents the water quality guidelines for the open waters of Lake Superior as recommended by the Technical Committee and includes the following parameters:

Dissolved oxygen, turbidity, color, total dissolved solids, total coliform bacteria, fecal coliform bacteria, methylene blue active substances, phenol, ammonia nitrogen, phosphorus, iron, cadmium, chromium, copper, lead, nickel, zinc, cyanide, hydrogen sulfide, taste, temperature, pH, radioactivity, and general statements covering other nonpersistent or persistent wastes.

Appendix B presents the Committee's rationale for water quality guidelines. The rationale reflects the agreements reached within the Committee.

Waters not defined as inshore waters or mixing zones will be considered as open waters and should reflect the general quality of the lake. Mixing zones may be set by the respective State agencies and reviewed by the FWQA. Waters within the mixing zones must meet specialized water quality criteria set by the States and in no case can the 96-hour median tolerance limit be exceeded for organisms that inhabit the area and the area shall be:

Free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits:

Free from floating debris, oil, scum and other floating materials or other discharges in amounts sufficient to be unsightly or deleterious;

Free from discharged materials that produce color, odor or other conditions in such degree as to create a nuisance;

Free from substances and conditions or combinations thereof in concentrations that produce undesirable aquatic growths.

Chairman Stein and conferees, our recommendations are as follows:

The public, this Committee, and the State and Federal regulatory agencies recognize the uniqueness of Lake Superior. To protect Lake Superior's water quality, with the best interests of the public being the principal consideration, the Committee respectfully recommends:

1. That the conferees adopt the proposed water quality guidelines for the open waters of Lake Superior as developed by their technical committee.

2. That the guidelines serve as an administrative instrument to the State and Federal regulatory agencies in the consideration of wastewater discharges and cultural activities that affect Lake Superior.

3. That the States of Michigan, Minnesota and Wisconsin consider these guidelines when revising their water quality standards for Lake Superior, in accordance with the Federal Water Quality Act of 1965.

4. That data collected in accordance with

Conference Recommendation 4, which states in part that "The FWPCA and the States substantially strengthen water quality surveillance plans for the Lake Superior Basin..." be compiled and disseminated by FWQA. These data will be used in revising the proposed guidelines.

Respectfully submitted by the Lake Superior Water Quality Technical Committee, Dale S. Bryson, Chairman.

(Which said report in its entirety is as follows:)

Water Quality Guidelines for Lake Superior

LAKE SUPERIOR

Prepared by the
Lake Superior Water Quality Technical Committee
of the
Lake Superior Enforcement Conference
April, 1970

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
GREAT LAKES REGION
33 EAST CONGRESS PARKWAY, ROOM 410
CHICAGO, ILLINOIS 60605

Water Quality Guidelines for Lake Superior

Prepared by the
Lake Superior Water Quality Technical Committee
of the
Lake Superior Enforcement Conference
April, 1970

TABLE OF CONTENTS

Page

I. INTRODUCTION 1

II. PRESENT WATER QUALITY STANDARDS 3

III. WATER QUALITY GUIDELINES 4

IV. RECOMMENDATIONS 7

APPENDIX A 9

APPENDIX B 13

LIST OF TABLES

Table

1 . . . . Proposed Water Quality Guidelines for the Open Waters of Lake Superior 5

I. INTRODUCTION

On the basis of reports, surveys or studies the Secretary of the Interior on January 16, 1969 called a conference in the matter of pollution of the interstate waters of Lake Superior and its tributary basin (Minnesota-Wisconsin-Michigan) under the provisions of Section 10 of the Water Pollution Control Act as amended.

The conference was held May 13-15, 1969 and an executive session was held September 30 – October 1, 1969 at Duluth, Minnesota.

At the executive session the conferees reached a number of conclusions and recommendations after appraising water pollution in the Lake Superior basin. They agreed the water quality in Lake Superior is generally unequalled anywhere in the world and that steps should be taken to protect that quality for future generations.

Recommendation Number 1 concerned itself specifically with the development of appropriate water quality criteria for the lake. That recommendation states:

> "It is recommended that a technical committee to evaluate water quality criteria for Lake Superior be formed of the conferees and such representatives as they may designate, within two weeks of the executive session. The purpose of the committee is to develop particular water quality criteria as guidelines for modification of the Federal-State water quality standards. The provision of the necessary secretarial assistance to the committee will be the responsibility of the Federal conferee. The committee may coordinate its activities with other committees or agencies, or engage consultants, as it determines appropriate. At the next session of the conference, the committee will report to the conferees on recommendations agreed upon for changing or modifying existing water quality criteria to reflect desired quality conditions in Lake Superior."

Representatives to the Lake Superior Water Quality Technical Committee designated by the conferees held meetings in Madison, Wisconsin on December 12, 1969; Chicago, Illinois on January 27-28, 1970; Minneapolis, Minnesota on February 23-24, 1970; and Chicago, Illinois on April 3, 1970.

The following committee was designated to represent the conferees:

Dale S. Bryson, Federal Water Pollution Control Administration (Chairman)

Glen D. Pratt, Federal Water Pollution Control Administration (Replaced Frank E. Hall)

Carlos M. Fetterolf, Michigan Water Resources Commission

Francis B. Frost, Michigan Water Resources Commission

Lyle H. Smith, Minnesota Pollution Control Agency

Clarence A. Johannes, Minnesota Pollution Control Agency (Alternate John F. McGuire)

Lloyd A. Lueschow, Wisconsin Department of Natural Resources

Jerome R. McKersie, Wisconsin Department of Natural Resources

INTRODUCTION (Con't)

Representatives of the Canadian National Government and the Province of Ontario were invited to the meetings and participated as observers.

This report of the Lake Superior Water Quality Technical Committee contains recommendations based on information from published material, testimony of experts, unpublished data from ongoing studies, information presented at the Lake Superior Enforcement Conference and from the background and experience of the committee members.

A great deal of technical background information pertinent to the establishment of water quality criteria was discussed by the committee in their deliberations. The committee felt it was not appropriate to summarize in this report the basic philosophy concerning water quality criteria as related to the various water uses as this is available in the National Technical Advisory Committee's publication entitled "Water Quality Criteria" dated April 1, 1968. The reader is referred to pages 29 and 30 in particular for the basic philosophy which prevailed throughout the discussions concerning water quality criteria for fish and other aquatic life.

The committee felt there was insufficient information on many parameters to adequately delineate the existing quality of the open waters of Lake Superior. This lack affected some of the committee's recommendations.

The committee recognized that a distinction must be made between inshore and open lake waters. The intent of the committee was to identify criteria sufficiently sensitive to signal small changes indicative of potential degradation of the existing open water quality in Lake Superior. Inshore waters were defined as areas affected by tributary stream plumes, shore erosion, thermal bars, or bottom sediments resuspended by wave action. It was recognized that inshore waters would not be static but would change with varying climatological conditions. Waters not defined as inshore waters or mixing zones would be considered as open waters and should reflect the general quality of the lake.

II. PRESENT WATER QUALITY STANDARDS

Water quality standards have been adopted for Lake Superior by the Lake Superior States and approved by the Department of the Interior as required under the provisions of the Water Quality Act of 1965. Michigan's standards for temperature were excepted from approval. The States assigned their highest water use categories to Lake Superior, namely, public water supply, whole-body contact recreation and cold water fishery and included non-degradation clauses. Hence, the water quality standards for Lake Superior are the most restrictive adopted by the States of Michigan, Minnesota and Wisconsin and are among the most stringent standards nationally. The criteria adopted were established using the best available information at that time.

A problem inherent in interpretation of water quality standards occurs where numerical values for a certain parameter are assigned under one water use and not assigned under another. For example, a State may classify a body of water for public water supply and cold water fishery. The zinc criteria as established in the public water supply category would be 5 mg/1, maximum allowable concentration in conformance with the U. S. Public Health Service Drinking Water Standards. Yet such a concentration of zinc would be fatal to most aquatic life inhabiting that water body. Therefore, should the State not establish a numerical value for zinc in the cold water fishery classification, it may appear that a concentration of 5 mg/1 of zinc would be allowed in those waters. This type of conflict is evident in waters that have a multiple use classification.

Appendix A lists the water quality criteria adopted by the States of Michigan, Minnesota and Wisconsin for the open water of Lake Superior. A copy of the complete States standards is available from the appropriate State agency.

The existing water quality standards for Lake Superior were designed to protect the waters near the shore of the lake. If these waters are fully protected from adverse quality effects, the open waters of Lake Superior, or the general quality of the lake, will not be degraded.

III. WATER QUALITY GUIDELINES

Before truly appropriate water quality criteria can be established for a body of water the existing quality must be fully assessed. This assessment permits determination of areas of the lake in which concentrations of certain parameters approach undesirable limits and establishes a baseline quality from which to measure future changes.

The waters of Lake Superior are among the least studied of any of the Great Lakes. Some data have been gathered principally in near-shore areas over the years by miscellaneous governmental agencies and universities. However, comprehensive data on the open lake are not available.

The committee gathered Lake Superior water quality information from the United States and Canada and used these data to assess the existing quality. The committee also gathered as much information as was available on recently completed and ongoing research concerning criteria for waters similar to Lake Superior. FWPCA's National Water Quality Laboratory at Duluth, Minnesota furnished the bulk of these data. Discussions with personnel at that laboratory proved invaluable throughout the committee's deliberations.

The Water Quality Act of 1965 provided that after the initial setting of standards periodic review and revision would be required to take into account changing technology and advances in knowledge of water quality requirements. Ultimately, truly appropriate water quality criteria will be developed for specific bodies of water.

The committee agreed that although the existing water quality standards on Lake Superior were very restrictive, some were not truly appropriate because they were drafted for all high quality waters of the States, not specifically for the open waters of Lake Superior. Because data were not available to completely assess existing quality in the lake and because the existing standards include non-degradation clauses, the committee concluded it was not appropriate to recommend new water quality criteria for establishment as standards for the open waters at this time. The committee did feel that existing water quality data were sufficient to permit recommendation of adoption of water quality criteria guidelines. These guidelines will permit monitoring of small changes which may signal potential degradation of existing open water quality in Lake Superior. They will serve as an administrative instrument to the State and Federal regulatory agencies in the consideration of wastewater discharges and cultural activities that affect Lake Superior. These guidelines should be revised as additional background data become available. At some future time the States of Michigan, Minnesota and Wisconsin should consider these guidelines when revising their water quality standards for Lake Superior in accordance with the Federal Water Quality Act of 1965.

The FWPCA's report, "An Appraisal of Water Pollution in the Lake Superior Basin", as prepared for the use of the conferees at the Lake Superior Enforcement Conference included details of proposed water quality criteria. Appendix C to that report contained the rationale for the proposed criteria. These criteria and rationale were used as a base for the discussion of guidelines by the committee.

Table 1 presents the water quality guidelines for the open waters of Lake Superior as recommended by the technical committee. Appendix B presents the committee's rationale for water quality guidelines. The rationale reflects the agreements reached by the committee.

Waters not defined as inshore waters or mixing zones will be considered as open waters and should reflect the general quality of the lake. Mixing zones may be set by the respective State agencies and reviewed by the FWPCA. Waters within the mixing zones must meet the conditions as noted in Table 1, Footnote 1.

TABLE 1

PROPOSED WATER QUALITY GUIDELINES FOR THE OPEN WATERS OF LAKE SUPERIOR[1]

(Mg/1 unless otherwise specified)[2]

Parameter	90% Value[3]	Maximum Value[4]
Dissolved Oxygen	>10.0	9.0
Turbidity	0.5 JTU	5.0 JTU
Color[5] Wavelength A[6]	0.05 absorbance units (turbidity removed)	0.25 absorbance units (turbidity removed)
Wavelength B[7]	0.50 absorbance units (turbidity removed)	2.50 absorbance units (turbidity removed)
Total Dissolved Solids	65.0	-
Total Coliform Bacteria[8]	10 per 100 ml	1,000 per 100 ml
Fecal Coliform Bacteria[8]	10 per 100 ml	200 per 100 ml
MBAS[9] – no material increase		
Phenol	-	0.001
Ammonia Nitrogen	0.05	0.1
Phosphorus[10]	-	0.01
Iron[11]	0.03	0.1
Cadmium[12]	0.002	0.005
Chromium	0.02	0.05
Copper	0.008	0.012
Lead	0.03	0.05
Nickel	0.015	0.03
Zinc[13]	0.01	0.015
Cyanide	0.002	0.004
Hydrogen Sulfide (as total sulfide measured at bottom-water interface)	0.002	0.02
Taste[14] Chloroform Extracts	0.03	0.05
Temperature[15] – no material increase		
pH[16] – Should remain between 6.8 and 8.5 units		

Radioactivity – Recommendations for proposed radiological criteria will be deferred pending development of model criteria by Federal Water Pollution Control Administration, Atomic Energy Commission and U. S. Public Health Service. When these model criteria are published an appropriate review will be made at that time to determine their suitability for the open waters of Lake Superior.

General – For non-persistent wastes and/or those that have noncumulative effects discharged directly to Lake Superior and for other individual chemicals the 90 percent value is 1/20 of the 96-hour TL_m value and the maximum value is 1/10 of the 96-hour TL_m value. For persistent complex wastes and/or those that have cumulative effects and other individual materials the 90 percent value is 1/100 of the 96-hour TL_m value and the maximum value is 1/20 of the 96-hour TL_m value. Decision on the determination of persistent and non-persistent wastes shall be that of the regulatory agencies.

[1] Inshore waters are defined as areas affected by tributary stream plumes, shore erosion, thermal bars, or bottom sediments resuspended by wave action. Waters not defined as inshore waters or mixing zones will be considered as open waters. Mixing zones may be set by the respective State agencies and reviewed by the Federal Water Pollution Control Administration. In these zones other standards may be applicable

TABLE 1 (Con't)

but in no case can the 96-hour TL_m value be exceeded for organisms that inhabit the area and the area shall be:

Free from substances attributable to municipal, industrial or other discharges that will settle to form putrescent or otherwise objectionable sludge deposits;
Free from floating debris, oil, scum and other floating materials or other discharges in amounts sufficient to be unsightly or or deleterious;
Free from discharged materials that produce color, odor or other conditions in such degree as to create a nuisance;
Free from substances and conditions or combinations thereof in concentrations that produce undesirable aquatic growths.

2 Concentrations of metals are listed on a total ion basis from unfiltered samples.

3 90% of the values obtained at one location must not exceed this value. (For dissolved-oxygen the stated value is a minimum.) Concentrations exceeding these values signal changes of water quality indicative of potential degradation and warrant further investigation.

4 Maximum value not to be exceeded. (For dissolved-oxygen the stated value is a minimum.)

5 Values adopted pending collection of additional data utilizing extended wavelength technique.

6 Wavelength A: 4000-8000 angstroms, 10 centimeters light path.

7 Wavelength B: 2400-4000 angstroms, 10 centimeters light path.

8 Analyses performed by the membrane filter technique.

9 Increases in MBAS concentrations signal changes of water quality which may be indicative of potential degradation and warrant further investigation.

10 The existing level of phosphorus in some areas of Lake Superior is greater than the proposed 0.01 mg/1 maximum limit and is cause for concern. Every effort should be made to reduce phosphorus inputs into the lake.

11 Values adopted pending collection of additional data.

12 Values adopted pending collection of additional data at which time the levels will be reconsidered and possibly lowered to a 90% value of 0.001 mg/1 and a maximum value of 0.002 mg/1.

13 Existing levels of zinc in the St. Mary's River are greater than those proposed and are cause for concern. Every effort should be made to eliminate sources of zinc.

14 No discharge that will impart a taint to fish flesh or produce an off flavor in drinking water will be permitted.

15 It is the policy of the Committee that there shall be no material increase in the temperatures of the open water of Lake Superior. Appropriate numerical values for temperature will be established at a later date from values obtained by additional sampling.

16 The objective is to not allow a trend from existing mean values.

IV. RECOMMENDATIONS

The public, this committee, and the State and Federal regulatory agencies recognize the uniqueness of Lake Superior. To protect Lake Superior's water quality, with the best interests of the public being the principal consideration, the committee respectfully recommends that:

1. The conferees adopt the proposed water quality guidelines for the open waters of Lake Superior as developed by their technical committee.
2. The guidelines serve as an administrative instrument to the State and Federal regulatory agencies in the consideration of wastewater discharges and cultural activities that affect Lake Superior.
3. The States of Michigan, Minnesota and Wisconsin consider these guidelines when revising their water quality standards for Lake Superior, in accordance with the Federal Water Quality Act of 1965.
4. Data collected in accordance with Conference Recommendation 4, which states in part that "The FWPCA and the States substantially strengthen water quality surveillance plans for the Lake Superior Basin . . ." be compiled and disseminated by FWPCA. These data will be used in revising the proposed guidelines.

Prepared by:

Lake Superior Water Quality Technical Committee
Dale S. Bryson, Chairman
April 3, 1970

APPENDIX A

LAKE SUPERIOR OPEN WATERS
WATER QUALITY CRITERIA AND DESIGNATED USES
MICHIGAN, MINNESOTA, WISCONSIN

STATE	DESIGNATED USES	COLIFORM GROUP	DISSOLVED OXYGEN	SUSPENDED, COLLOIDAL AND SETTLEABLE MATERIALS	FLOATING MATERIAL, RESIDUES, DEBRIS AND MATERIAL OF UNNATURAL ORIGIN	TOXIC AND DELETERIOUS SUBSTANCES
MICHIGAN	Domestic Water Supply Industrial Water Supply Recreation: – Whole Body Contact – Partial Body Contact Fish, Wildlife and Other Aquatic Life: – Intolerant Fish Cold Water Species – Intolerant Fish Warm Water Species Agricultural Commercial	The average of any series of 10 consecutive samples shall not exceed 1000 organisms per 100 ml nor shall 20% of samples exceed 5000/100 ml Fecal coliforms for the samples ≯100/100 ml	Cold Water Intolerant Species ≮6 mg/1 at any time Warm Water Intolerant Species Avg. Daily Value ≮5 mg/1 Any Single Value ≮4 mg/1	No objectionable unnatural turbidity, color, or deposits in quantities sufficient to interfere with designated use	No evidence of such material except of natural origin No visible film of oil or globules of grease	Conform to current USPHS Drinking Water Standards, except: Cyanide: ≯0.2 mg/1 Chromium: ≯0.05 mg/1 Phenols: Mo. Avg. ≯0.002 mg/1 Single Value ≯0.005 mg/1 Not to exceed 1/10 of the 96-hour TL_m obtained from continuous flow bioassays where the dilution water and toxicant are continuously renewed except that other application factors may be used in specific cases when justified on the basis of available evidence and approved by the appropriate agency
MINNESOTA	Domestic Consumption (IB) Fisheries and Recreation (2A) Industrial Consumption (3A)	≯50 MPN/100 ml	Oct-May ≮ 7.0 mg/1 Jun-Sep ≮ 5.0 mg/1	Turbidity ≯5.0 units No discharge from unnatural sources so as to cause any nuisance conditions	Oil ≯ Trace No discharge from unnatural sources so as to cause any nuisance conditions	[≯ - mg/1] Arsenic 0.01 Barium 1.0 Cadmium 0.01 CCE 0.2 Chromium Trace Copper Trace Cyanide Trace Fluorides 1.5 Lead 0.05 Manganese 0.05 Nitrates 45.0 Selenium 0.01 Silver 0.05 Zinc 5.0
WISCONSIN	Public Water Supply Industrial and Cooling Water Commercial Shipping Recreation: – Whole Body Contact Beach areas Fish and Aquatic Life Trout Waste Assimilation	Arith. Avg. ≯1000/100 ml Max. ≯2500/100 ml during recreation season	≮80% Saturation nor ≮5 mg/1 at any time ≯1 mg/1 change	Substances that will cause objectionable deposits in the bed or on the shore of a body of water shall not be present in such amounts as to create a nuisance	Floating or submerged debris, oil, scum or other material shall not be present in such amounts as to create a nuisance	Substances in concentrations or combinations which are toxic or harmful to humans shall not be present in amounts found to be of public health significance, nor shall substances be present in amounts, which by bioassay and other appropriate tests, indicate acute or chronic levels harmful to animal, plant or aquatic life

> Greater Than	≯ Not Greater Than
< Less Than	≮ Not Less Than

Where designated uses have different criteria the most stringent criteria are listed.

TOTAL DISSOLVED SOLIDS	NUTRIENTS	TASTE AND ODOR PRODUCING SUBSTANCES	TEMPERATURE	pH	RADIOACTIVE MATERIALS
Total Dissolved Solids: ≯ 200 mg/1 Chlorides: Mo. Avg. ≯ 50 mg/1 (MICHIGAN)	Nutrients originating from industrial, Municipal or domestic animal sources shall be limited to the extent necessary to prevent adverse effects on water treatment processes or the stimulation of growth of algae, weeds and slimes which are or may become injurious to the designated use	Concentrations of substances of unnatural origin shall be less than those which are or may become injurious to the designated use Phenols: Mo. Avg. ≯ 0.002 mg/1 Max. Concentration for a Single Value ≯ 0.005 mg/1	Excepted from Approval	Range of 6.5 - 8.8 ≯ 0.5 unit change within range	≯ 1000 pc/l of gross beta activity in absence of Sr-90 and alpha emitters If this limit is exceeded the specific radionuclides present must be identified by complete analysis in order to establish the fact that the concentration of nuclides will not produce exposure above recommended limits established by the Federal Radiation Council
Total Dissolved Solids: ≯ 500 mg/1 Chlorides: ≯ 50 mg/1 Sulfates: ≯ 250 mg/1 Hardness: ≯ 50 mg/1 (MINNESOTA)	No discharge from unnatural sources so as to cause any nuisance conditions	Threshold Odor: Number ≯ 3 Phenols: ≯ 0.001 mg/1	No Material Increase	Within range of 6.5 - 8.5	Gross beta concentration not to exceed 1000 pc/1 in known absence of alpha emitters and Sr-90 Also: Not to exceed the lowest concentrations permitted to be discharged to an uncontrolled environment as prescribed by the appropriate authority having control over their use
Mo. Avg. ≯ 500 mg/1 Max. ≯ 750 mg/1 at any time (WISCONSIN)	Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to create a nuisance	Materials producing color, odor, taste or unsightliness shall not be present in such amounts as to create a nuisance	84°F Max. Change from natural unpolluted background ≯ 5°F Rate of Change ≯ 2°F/hour	Within range of 6.0 - 9.0 ≯ 0.5 unit change if natural values are above 8.5 or below 6.5	Intake water supply will be such that by appropriate treatment and adequate safeguards it will meet PHS Drinking Water Standards, 1962

APPENDIX B

INDEX TO APPENDIX B

Page
Dissolved Oxygen 15
Turbidity and Color 16
Total Dissolved Solids 17
Bacteria 17
Methylene Blue Active Substances (MBAS) 18
Phenols and Phenolic Compounds 19
Ammonia 20
Phosphorus 21
Iron 22
Cadmium 23
Chromium 24
Copper 25
Lead 26
Nickel 27
Zinc 28
Cyanide 29
Hydrogen Sulfide 30
Taste 30
Temperature 31
pH 33
Radioactivity 34
All Other Pollutants 35

DISSOLVED OXYGEN

I. **BIOLOGICAL EFFECTS.** A continuous supply of oxygen is required for the normal metabolism of fish and most of their food organisms. Oxygen is used also in the respiration of plants and by bacteria. Oxygen enters the water chiefly by diffusion from the air and by the photosynthetic activity of plants. In general a balance is maintained between addition and removal, but because oxygen is not very soluble the water's capacity is small, so that any interference with the influx from the air or production by plants or any sudden increase in utilization (as, for example, in the bacterial oxidation of sewage wastes, etc.) soon lowers it to critical levels.

The oxygen concentration needed for maintenance varies widely with species, and there is evidence that highly desirable fish species in Lake Superior (coregonids, salmonids) require relatively high concentrations. There are indications, also, that several of the important food organisms (gammarids and shrimp) are even less tolerant of oxygen deficiencies. Within any one species the requirement varies with temperature, and especially with life-history stage, the eggs and early fry being more sensitive than the adults to oxygen lack. For such cold-water fish as salmonids a minimum of 6 mg/1 has been recommended for good growth and general well-being of adults and their associated food organisms, and of 7 mg/1 for eggs and fry.

II. **SPECIAL CONSIDERATIONS.** In addition to providing for growth, activity, reproduction and the like, the oxygen concentration must be high enough to protect against adverse conditions that may be encountered. For example, toxicants that enter through the gills become more toxic as the oxygen concentration is decreased, because the fish must pass more water over the gills to get enough oxygen, and this brings more toxicant against the gill surface. Because the low salt content of Lake Superior water permits such agents as heavy metals to be more toxic than they would be in harder waters, it is especially important that the oxygen concentration be maintained high enough to counteract this hazard.

Little is known about the requirements of the adult stages of the important species of fish and food organisms under the environmental conditions of the bulk of Lake Superior, and even less about those of the more sensitive developmental stages. Further, little seems to be known about the oxygen concentration in various parts of the lake, especially at the bottom where the eggs and early stages of many species must live. Evidently the lake oxygen concentrations that have entered into maintaining the recorded levels at Duluth and Sault Ste. Marie so far have been high enough to maintain the aquatic population, and these should serve as guidelines until we have more information.

It is important to recognize that a reduction in oxygen from existing concentrations would serve as a warning of organic decomposition with subsequent release of poisonous materials such as hydrogen sulfide and ammonia.

III. **EXISTING CONDITIONS.** The gross range of dissolved oxygen concentrations over the period 1958-1968 was between 9.4 and 14.6 mg/1 at Duluth, and 8.4 and 16.4 mg/1 at Sault Ste. Marie, with means of 12.6 and 12.2 mg/1, respectively.

IV. **RECOMMENDED CRITERIA FOR LAKE SUPERIOR.** The dissolved oxygen concentration of the open water of the lake shall not be less than 9 mg/1, at any time or any place in that habitat and 90% of the values should be greater than 10 mg/1. For habitats occupied primarily by warmer water fish (e.g., perch and walleye in the shallower bays) the criteria shall be not less than 5 mg/1 at any time or place in that habitat.

V. REFERENCES.

1. Brinley, F.J. 1944. House Document 266, 78th Congress, 1st Session. Part II, Supplement F, Biological Studies, pp. 1275-1353.
2. Doudoroff, P. and C.E. Warren, 1962. Biological Problems in Water Pollution. Public Health Service; Third Seminar: pp. 145-155. Dissolved Oxygen Requirements of Fishes.
3. Ellis, M.M. 1937. Bulletin U.S. Bureau of Fisheries, Volume 48:365-437. Detection and Measurement of Stream Pollution.
4. Smith, L.L. et al, 1956. Sewage & Industrial Wastes 28:678-690. Aquatic Life Water Quality Criteria: Second Progress Report.
5. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C., April 1968.

TURBIDITY AND COLOR

I. BIOLOGICAL EFFECTS. Ecologically, the quality of the light, the intensity and the duration impinging on a given surface area controls the ecosystem through its influence on primary production. Light is the ultimate source of energy, without which life could not exist. Many structural and behavorial characteristics of organisms are directly influenced by light, therefore making it a vital factor as well as a limiting one at both the maximum and minimum levels.

Reduction of light presents a more serious problem in the aquatic environment than in the terrestrial. Light diminishes rapidly even in clear water, and changes in spectral composition and in other respects. Any extraneous material which is introduced to water, whether it be dissolved or suspended, will diminish the light intensity and possibly change the light quality. In short, suspended or dissolved solids absorb light energy, and this absorption will decrease that light energy available for primary production.[1]

Production takes place in the water at a depth to which light penetrates so that in deep water lakes the light-penetrated "surface water" provides the major source of production for the entire depth.[2] Effects of turbidity on desirable fish in Lake Superior would first appear as indirect ones on food supply.

II. CHEMICAL EFFECTS. Increases in turbidity require an increase in the available chlorine necessary for chlorination.[3] Further, an increase in turbidity makes phosphate and radioactivity removal harder to accomplish.[4] Turbidity produces in Lake Superior "colored water" which is not esthetically pleasing.[5]

III. SPECIAL CONSIDERATIONS. Since Lake Superior is deep (average depth about 600 feet) and cold (average temperature <42°F) primary production is already hindered. If light energy is removed because of turbidity or color, further stress would be placed on the lake's primary production. A combination of all these adverse conditions (extreme depth, low temperature, and light absorption) could render the lake practically sterile. Since the lake's depth cannot be controlled, and the cold temperature is required for the natural fish, it is most imperative that turbidity and color be removed from effluents being discharged into the lake.

IV. EXISTING CONDITIONS. Twenty-year averages of turbidity measurements taken daily at the Duluth Water Treatment Plant (Lakewood Pumping Station) show the mean turbidity of Lake Superior at this station to be about 0.3 JTU.

V. RECOMMENDED CRITERIA FOR LAKE SUPERIOR.

Turbidity: Less than 0.5 JTU (measured by light scattering and dilution of standard solutions for JTU) for 90% of the time. Not to exceed 5.0 JTU as maximum.

Color: **Committee Recommendation:** *Less than 0.050 absorbance units (10 cm path length, turbidity removed) over wave length range 4000-8000 A, and less than 0.500 absorbance units (10 cm path length, turbidity removed) over the wave length range 2400-4000 A for 90% of the time. Not to exceed five times these values as a maximum. Values adopted pending collection of additional data utilizing extended wavelength technique.*

VI. REFERENCES.

1. Odum, E.P. Fundamentals of Ecology, p. 106. W. B. Saunders and Co., Philadelphia, 1959.
2. Clarke, G.L. Elements of Ecology, p. 185, John Wiley and Sons, Inc., New York. 1954.
3. Felsen, D. and Taras, M.J. Journal American Water Works Association, 42, 455 (1950).
4. Eliassen, R. et al. Journal American Water Works Association, 43, 621 (1951).
5. Basic Studies on Environmental Impacts of Taconite Waste Disposal, Part I and II, U.S. Department of the Interior, December, 1969.

TOTAL DISSOLVED SOLIDS

I. GENERAL CONSIDERATIONS. The quantity of dissolved solids by itself is not especially important in assessing water quality. More important are the kinds of dissolved solids that are present, and in some cases, the ratio of one to another. Only when the total exceeds many times the existing values in the lake, would there be any direct impairment.

Dissolved solids measurements do, however, provide a good index of the aging rate of the lake. Such correlations have been established in Lake Erie, as an example. For this reason, dissolved solids should be kept close to the present level to avoid undesirable aging effects.

II. EXISTING CONDITIONS. No data is available for St. Mary's River, but rarely is 60 mg/1 reached at Duluth.

III. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. Ninety percent of the values should not exceed 65 mg/1.

IV. REFERENCES.

1. A Plan for Water Pollution Control - Lake Erie Report. U. S. Department of the Interior, Federal Water Pollution Control Administration. August 1968.

BACTERIA

I. GENERAL CONSIDERATIONS. The presence of bacteria in water was recognized early as an indicator of degraded water quality. The coliform bacterial count has been most widely used as an index of sewage contamination and possible accompanying hazard of human pathogens. Some waters have a high count even though there is little or no sewage contamination as coliform bacteria enter waterways from sources other than man, such as land runoff from agricultural lands.

The cold temperature, extreme water clarity (permitting deep penetration of sunlight) and sparsely populated watershed result in very low counts. The average total coliform value at Duluth is 3.68/100 ml and 7.81/100 ml at the St. Mary's River.

II. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The maximum total coliform count should not exceed 1000/100 ml and 90% of the counts should be less than 10/100 ml at any location. The maximum fecal coliform count should not exceed 200/100 ml and 90% of the counts should be less than 10/100 ml at any location.
Additional Committee Recommendation: *Analyses performed by the membrane filter technique.*

III. REFERENCES.

1. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C., April 1968.
2. Sanitary Significance of Fecal Coliforms in the Environment. U.S. Department of the Interior, Federal Water Pollution Control Administration, Publication WP-20-3.
3. The Bacteria, Volume II. Gunsalus and Stanier, Academic Press. 1961.
4. Pollutional Effects of Pulp and Paper Mill Wastes in Puget Sound. U.S. Department of the Interior, Federal Water Pollution Control Administration, March 1967.
5. Proceeding-Eleventh Conference on Great Lakes Research - 1968. International Association for Great Lakes Research.
6. Microbiology for Sanitary Engineers. McKinney, Rose E. McGraw-Hill, 1962, pp. 152.

METHYLENE BLUE ACTIVE SUBSTANCES (MBAS)

I. GENERAL CONDITIONS. *The methylene blue method is used for quantitatively measuring surfactants, but does not differentiate between the now existing levels of ABS and LAS occurring in natural waters. Nor does the method differentiate between surfactants and certain natural substances. Therefore, it has been proposed and generally accepted that these anionic substances be reported as methylene blue active substances (MBAS).*

The MBAS test provides very sensitive measurement of increases in concentrations of organic compounds in Lake Superior. While the MBAS method does not yield a differentiation of compounds it provides a quantitative measure of change and signals potential degradation of water quality that warrants investigation.

II. EXISTING CONDITIONS. Available information on MBAS concentrations in Lake Superior indicates a range from 0.01 - 0.05 mg 1.

III. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. Committee Recommendation: *There shall be no material increase in the MBAS concentration in the open water of Lake Superior. Increases in the MBAS concentration signal changes of water quality which may be indicative of potential degradation and warrant further investigation.*

IV. REFERENCES

1. Thatcher, Thomas O., and Joseph F. Santner, 1966. Acute Toxicity of LAS to Various Fish Species. Proceedings 21st Purdue Industrial Waste Conference, Engineering Extension Series No. 121., 50(2): 996-1002.
2. Pickering, Quentin H. 1966. Acute Toxicity of Alkyl Benzene Sulfonate to the Eggs of the Fathead Minnow, Pimephales promelas. Air and Water Pollution Journal, 10: 385-391.
3. Pickering, Quentin H. and Thomas C. Thatcher. 1968. The Chronic Toxicity of Linear Alkylate Sulfonates to the Fathead Minnow (Pimephales promelas, Raf.). Journal Water Pollution Control Federation. In press.
4. Swisher, R.D., J.T. O'Rourke, and H.D. Tomlinson. 1964 Fish Bioassays of Linear Alkylate Sulfonates (LAS) and Intermediate Biodegradation Products. Journal of American Oil Chemical Society, 41: 746-752.
5. Marchetti, R. 1965. Critical Review of the Effects of Synthetic Detergents on Aquatic Life. Stud. Rev. Gen. Fish. Coun. Medit., No. 26, 32 pp.
6. Arthur, John W., 1970, Chronic Effects of Linear Alkylate Sulfonat Detergent on Gammarus pseudolimnaeus, Campeloma decisum, and Physa integra. Water Research, In press.

PHENOLS AND PHENOLIC COMPOUNDS

I. BIOLOGICAL EFFECTS. Phenols and substituted phenols are toxic to trout and other fish at concentrations of 0.1 to 10 mg/l. Studies of long term effects at lower concentrations have not been made.

Phenolic compounds, particularly the chlorophenols, cause unpleasant odors and flavors in fish from waters containing as little as 0.0001 mg/l. Most phenols are biodegradable, but at concentrations of a few mg/l or less cause nuisance slime and mold growths on rocks, etc.

II. SPECIAL CONSIDERATIONS. Phenols in drinking water are detectable by disagreeable taste and odor at concentrations of 0.001 to 0.01 mg/l, thus the U.S. Public Health Service Drinking Water Standard has been set at 0.001 mg/l. Current waste treatment practices (tertiary treatment) are highly efficient at removal of phenols; however, post-chlorination of the waste increases the proportion of taste and odor causing chlorophenols.

III. EXISTING CONDITIONS. Phenol as such is not routinely measured in Lake Superior. However, data from Duluth and the St. Mary's River indicate that total aromatics (including phenols) average less than 0.001 mg/l.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. Based on the potential for causing taste and odor problems in drinking water and in commercial fish, the recommended criteria for phenols in Lake Superior is a maximum concentration of 0.001 mg/l.

V. REFERENCES.

1. Brown, V.M., Jordan, D.H.M., and Tiller, B.A., 1967. The Effect of Temperature on the Toxicity of Phenol to Rainbow Trout in Hard Water. Water Research 1:587-594.
2. Pickering, Q.H., and Henderson, C., 1966. Acute Toxicity of Some Important Petrochemicals to Fish. Journal Water Pollution Control Federation 38 (9): 1419-1429.
3. Ryckman, D.W., Prabhakara Rao, A.V.S., and Buzzel, J.C., Jr. Behavior of Organic Chemicals in the Aquatic Environment: A Literature Critique. Published by the Manufacturers Chemists Association, Washington, D.C., Summer 1966.
4. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C., April 1968.

AMMONIA

I. BIOLOGICAL EFFECTS. Ammonia is a normal product of animal metabolism and the major nitrogenous excretion of fish and other freshwater animals. It enters water naturally also by microbial decomposition of decaying plant and animal material, in rain water and, under certain conditions, by the degradation of dissolved nitrites and nitrates. In addition, it enters water as a component of sewage, fertilizers, and numerous industrial wastes. Conversely, it serves as a nutrient for some of the algae. Its concentration is unlikely to remain constant in a normal aquatic environment, but tends to be decreased by conversion to nitrite and nitrate. Because of its many possible sources and fates, the ammonia content of natural unpolluted waters is highly variable, and has been reported to range from 0.0 to about 4.0 mg/1, although usually less than 0.2 mg/1.

The experimental work to date on ammonia toxicity does not provide clear guidelines, partly because the distinction has not always been made between the highly toxic ammonia molecule and the less toxic ammonium ion, and partly because the experiments have been too crude to be related to long-term effects. A concentration of 1.5 mg/1 has been reported as "not harmful to fish", but it has also been reported, however, that 1 mg/1 and even 0.3 mg/1 can affect the oxygen carrying capacity of the blood. Its effects on important fish food organisms of the lake are not known.

II. SPECIAL CONSIDERATION. The higher the pH the greater the proportion of toxic molecular ammonia relative to ammonium ion, the toxicity of ammonium compounds increasing by 200% or more between pH 7.4 and 8.0. Over the period 1958-1968 the pH of Lake Superior water at Duluth has ranged between 7.3 and 8.5, with a mean of 7.72, which is in a critical range for ammonia. Further, because of its low salt concentration Lake Superior water is poorly buffered against changes in pH. For these reasons the standard for ammonia must be extremely conservative to be safe for aquatic life.

III. EXISTING CONDITIONS. Over the period 1959-1966 at Sault Ste. Marie, and 1958-1965 at Duluth, the reported ammonia concentrations ranged between 0.0 and 0.1 mg/1 as ammonia nitrogen, with means of 0.071 and 0.0024 mg/1, respectively.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. Since the values so far recorded seem not to have had an adverse effect, since the ammonia concentration is highly labile, and since ammonia is most toxic at high pH ranges, the recommended criteria is a maximum of 0.1 mg/1, expressed as ammonia nitrogen, and 90% of the values should be less than 0.05 mg/1.

V. PERTINENT REFERENCES.

1. Doudoroff, P., and Katz, M., 1950 22:1432-1458. Critical Review of Literature on the Toxicity of Industrial Wastes and their Components to Fish. I. Alkalies, Acids and Inorganic Gases. Sewage and Industrial Wastes.
2. Ellis, M. M. 1937. Bulletin U. S. Bureau of Fisheries. Detection and Measurement of Stream Pollution. Vol. 48: 365-437.
3. Goldstein, L., Forster, R. P. and Fanelli, G. M., Jr. 1964. Gill Blood Flow and Ammonia Excretion in the Marine Teleost, Myoxocephalus scorpius. Comp. Biochem. Physiol. 12: 489-499.
4. Lloyd, R. 1961. Effect of Dissolved Oxygen Concentrations on the Toxicity of Several Poisons to Rainbow Trout. Journal Experimental Biology. 38: 447-456.

PHOSPHORUS

I. BIOLOGICAL EFFECTS. Phosphorus is an essential nutrient which frequently occurs in minute quantities in natural waters and can thereby be limiting to the growth of aquatic plants. When present in excess, however, under favorable environmental conditions, it is instrumental in producing heavy and undesirable growths of both algae and rooted aquatic plants. Results obtained by various workers (e.g., Sawyer, 1947; Chu, 1943; Strickland, 1965; and Sylvester, 1961) indicate that phosphorus does not become limiting to algae until concentrations as low as 0.01 mg/l or less of soluble phosphorus are reached.

II. SPECIAL CONSIDERATIONS. Phosphorus, in increased quantities, is commonly associated with accelerated lake eutrophication. The degree to which aquatic plant growth is stimulated by phosphorus is variable, and will depend on the occurrence of other essential nutrients, temperature, light, etc. Phosphorus is, however, a substance which is essential to plant growth, one which is frequently limiting, and one which is much more amenable to control than many other nutrients. Nitrogen, for example, is difficult to control because some forms of algae are able to fix atmospheric nitrogen.

III. EXISTING CONDITIONS. Data on phosphorus distribution in Lake Superior are scarce. A synthesis of data published by Putnam and Olson (1960) and by Beeton, et al. (1959), indicate average distribution of total phosphorus, as mg/l Phosphorus, for all depths, to be as follows:

West End (West of Apostle Islands)	0.009
Apostle Islands Region	0.014
Open Lake, Apostle Islands to Keweenaw Peninsula	0.010
Keweenaw Bay	0.011
Coastal Waters off Marquette and Munising	0.010
Open Lake, East End	0.005
Whitefish Bay	0.008

The average for the entire lake is 0.0096 mg/l.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The total phosphorus levels should not be permitted to exceed existing values. Where background data are not available the maximum value should not exceed 0.01 mg/l total phosphorus. **Additional Committee Recommendation:** *The existing level of phosphorus in some areas of Lake Superior is greater than the proposed 0.01 mg/l maximum limit and is cause for concern. Every effort should be made to reduce phosphorus inputs into the Lake.*

V. REFERENCES.

1. Beeton, A.M., J.H. Johnson, and Stanford H. Smith, 1959. Lake Superior Limnological Data. U.S. Fish and Wildlife Service. Special Scientific Report – Fisheries No. 297, Washington, D.C., 177p.

2. Chu, S.P., 1943. The Influence of the Mineral Composition of the Medium on the Growth of Planktonic Algae. Part II. The Influence of the Concentration of Inorganic Nitrogen and Phosphate Phosphorus. J. Ecology, 31:109.

3. Putnam, H.D., and T.A. Olson. An Investigation of Nutrients in Western Lake Superior. School of Public Health, University of Minnesota, Duluth, for the Minnesota Water Pollution Control Commission, 1960.

4. Putnam, H.D., and T.A. Olson, 1966. Primary Productivity at a Fixed Station in Western Lake Superior. Proceedings, Ninth Conf. on Great Lakes Res., Inst. of Sci. and Tech., University of Mich., Ann Arbor, p. 119-128.

5. Sawyer, C.N., 1947. Fertilization of Lakes by Agricultural and Urban Drainage. J. NEWWA, 61:109.

6. Strickland, J.D.H., 1965. Production of Organic Matter in the Primary Stages of the Marine Food Chain. Chemical Oceanography (J.P. Riley and D. Skirrow, eds.), Academic Press, New York.

7. Sylvester, R.O., 1961. Nutrient Content of Drainage Water from Forested, Urban, and Agricultural Areas. Algae and Metropolitan Wastes, Public Health Service, SEC TR W61-3, 80, U.S. Govt. Print. Off., Washington, D.C.

IRON

I. BIOLOGICAL EFFECTS. Iron causes problems of taste, color and odor in water supplies and may stimulate the growth of bacteria and other lower plant life. It will discolor shore areas and may coat water conduits. Concentrations in excess of 0.3 mg/l cause taste problems and stain laundry. Lesser concentrations in combination with manganese often result in undesirable growths.

II. SPECIAL CONSIDERATIONS. Iron solubility is highly pH dependent. In more desirable pH values of 6.5 to 8.5 it occurs in the oxidized state and is rather insoluble and usually settles. Introductions of iron may result in an increase in settleable solids content in this way. Iron will redissolve in hypolimnionic waters under certain conditions and then may cause taste and odor problems.

III. EXISTING CONDITIONS. The ten year average concentration at Duluth is 0.023 mg/l and 0.019 mg/l at the St. Mary's River. The high value recorded is 0.168 mg/l. Highest readings occurred during the last several years.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The maximum value should be 0.1 mg/l and 90% of the values should be less than 0.03 mg/l at any single location. Additional Committee Recommendation: ***Values adopted pending collection of additional data.***

V. REFERENCES.

1. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C. April 1968.

2. U.S. Department of Health, Education and Welfare, 1962, Public Health Service Drinking Water Standards, PHS Publication No. 956.

3. Water Quality Criteria, California State Water Quality Control Board, Sacramento, California, Publication 3-A, 1963. pp. 215

CADMIUM

I. BIOLOGICAL EFFECTS. Cadmium occurs in small amounts in naturally occurring zinc ores reflecting its close chemical relationship to zinc but in natural waters occurs in only trace amounts. Cadmium is a nonessential, nonbeneficial element. It is a heavy metal that accumulates in animal tissues and has a high pollution potential because of its high toxicity and cumulative effects.

In the U.S. Public Health Service Drinking Water Standards, cadmium in excess of 0.010 mg/l constitutes grounds for rejection of the supply. Long term toxicity studies conducted at the Federal Water Pollution Control Administration's Newtown Fish Toxicology Laboratory have shown slow accumulative mortality in young fish and that newly hatched fry are extremely sensitive to cadmium. These chronic studies conducted in hard water (in which cadmium is less toxic than in Lake Superior) gave a "safe" concentration of 0.037 mg/l. The test concentration of 0.057 mg/l was lethal to newly hatched fry.

II. SPECIAL CONSIDERATION. The toxicity of cadmium, like the other heavy metals, is influenced by water quality characteristics, such as pH and hardness. Acute toxicity studies indicate that the lethal concentration of cadmium in softer water is 1 mg/l.

III. EXISTING CONDITIONS. According to Kopp and Kroner, of 66 samples in the Western Great Lakes Basin the frequency of detection (0.45 millipores filtered samples) was 3%. They did not detect cadmium in Lake Superior.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The recommended criteria for cadmium in Lake Superior is a maximum value of 0.005 mg/l and 90% of the measurements less than 0.002 mg/l at a single location. **Additional Committee Recommendation:** *Values adopted pending collection of additional data at which time the levels will be reconsidered and possibly lowered to a 90% value of 0.001 mg/l and a maximum value of 0.002 mg/l.*

V. REFERENCES

1. Pickering, Q.H., and Gast, M. The Chronic Toxicity of Cadmium to the Fathead Minnow (Pimephales promelas) (In preparation).

2. Pickering, Q.H., and Henderson, C. Acute Toxicity of Some Heavy Metals to Different Species of Warm Water Fishes, Proceedings 19th Industrial Waste Conference. Purdue University. 1965.

CHROMIUM

I. BIOLOGICAL EFFECTS. In the U. S. Public Health Service Drinking Water Standards the presence of hexavalent chromium in excess of 0. 05 mg/l shall constitute grounds for rejection of the supply. Chromium is not known to be either an essential or beneficial element in animals. There is accumulation of chromium in many animals and when inhaled, chromium is a known cancerigenic agent for man. Trivalent chromium is not of concern in drinking water supplies at present.

In long-term tests conducted at the Federal Water Pollution Control Administration's Newtown Fish Toxicology Laboratory, in a hard water, 1 mg/l of hexavalent chromium was found to be a "safe" concentration for survival and reproduction of the fathead minnow. The lethal value in a similar water (200 mg/l hardness) was 33 mg/l. In a soft water, low pH bioassay the lethal value for the fathead minnow was 17 mg/l.

Bioassays conducted with four species gave lethal values of hexavalent chromium that ranged from 17 to 118 mg/l. Thus it appears that there is a great range of sensitivity of various fish species. Hexavalent chromium appears to be more toxic to some invertebrates; 0. 05 mg/l is lethal to Daphnia, a very important animal in Lake Superior. In acute bioassays trivalent chromium is more toxic in soft water than hexavalent chromium. The chronic studies indicated that their toxicity is not greatly different.

II. Special Considerations. Hexavalent chromium is very soluble in water while trivalent chromium is much less soluble, especially in hard water. Many variables influence the toxicity of chromium. Trama and Benoit have shown that the toxicity of hexavalent chromium is dependent on pH; it is more toxic under conditions of low pH. The toxicity of trivalent chromium is dependent on concentration, pH, hardness, and equilibrium state.

III. EXISTING CONDITIONS. Hexavalent chromium concentrations found in Lake Superior at Duluth had a frequency of detection of 40%. In these samples of positive occurrence the mean concentration was 9 µg/l and the maximum was 20 µg/l. At St. Mary's River hexavalent chromium was found in 17% of the samples with a mean of 3 µg/l and a maximum of 7 µg/l. Data are not available for trivalent chromium concentrations.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The recommended criteria for total chromium is a maximum of 0. 050 mg/l and 90% of the values should be less than 0. 02 mg/l at any single location.

V. REFERENCES.

1. Pickering, Q. P., and Henderson, C. Acute Toxicity of Some Heavy Metals to Different Species of Warmwater Fishes, Proceedings 19th Industrial Waste Conference, Purdue University, 1965.

2. Trama, F. B., and Benoit, R. J. Toxicity of Hexavalent Chromium to Bluegills, Journal Water Pollution Control Federation, Volume 32, 1960.

COPPER

I. BIOLOGICAL EFFECTS. Copper is one of the more toxic of the heavy metals to many desirable aquatic organisms. It is also an essential trace element and is often added to the foods of both aquatic and terrestrial animals. It is commonly used to control algal growths in water supplies. The permissible concentration in public water supplies is 1 mg/l and the desirable concentration is virtually absent.

Experiments with trout, perch, sunfish, freshwater shrimp, Daphnia, snails, and clams establish the maximum no-effect concentrations in Lake Superior water to be between 0.01 and 0.05 mg/l. Trout, shrimp, and Daphnia, all important in Lake Superior, are among the most sensitive. To some animals, copper concentrations that kill are substantially higher than concentrations that retard growth and inhibit reproduction. Experimentation has shown that concentrations 1/10 to 1/30 of the lethal concentrations inhibit reproduction.

II. SPECIAL CONSIDERATION. Both pH and the calcium-magnesium content of water affects copper toxicity to aquatic organisms. The lethal concentrations are more affected by these characteristics than are the no-effect concentrations. Lake Superior water has low concentrations of calcium and magnesium and therefore copper is more toxic in it than in most other natural waters of the United States. For this reason, stringent criteria are needed.

III. EXISTING CONDITIONS. Five year average concentrations of copper at Duluth and the St. Mary's River are 0.003 and 0.005 mg/l, respectively. Some values have been reported as high as 0.02 mg/l, but nearly all are less than 0.01 mg/l. Except near sources of copper introduction, concentrations do not vary greatly.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The criteria for Lake Superior should be a maximum of 0.012 mg/l and 90% of the measurements should be less than 0.008 mg/l at any single location.

V. REFERENCES.

1. Sprague, J. B., Lethal Concentrations of Copper and Zinc for Young Atlantic Salmon, Journal of Fisheries Research Board, Canada, 21 (1), 1964.
2. Mount, Donald I. Chronic Toxicity of Copper to Fathead Minnows (Pimephales Promelas, Rafinesque). Water Research, 2:215-223, 1968.
3. Grande, Magne., Effect of Copper and Zinc on Salmonid Fishes, Third International Conference on Water Pollution Research, Section 1, Paper No. 5.
4. Sprague, J. B., Avoidance of Copper-Zinc Solutions by Young Salmon in the Laboratory. Journal Water Pollution Control Federation. Vol. 36 (8): 990-1004, 1964.
5. (Personal communication, National Water Quality Laboratory Staff.) Acute and Chronic Effects of Cu^{+2} on Fish and Invertebrates in Lake Superior Water, 1969.

LEAD

I. BIOLOGICAL EFFECTS. Lead is quite poisonous to aquatic organisms, concentrations of 0.1 mg/l having killed fish in soft water. In water more like that of Lake Superior, however, short term (a few hours to a few days) mortality test values of from 5 to 50 mg/l of lead have often been obtained.

The few longer term (up to six months), nonlethal exposures to lead in water have demonstrated that accumulations in various parts of the body result from continuous uptake of lead by the fish. Such accumulations in mammals have led to toxic effects and death after long periods of time, even many years. On the basis of available information on fish, similar results would be expected.

Daphnia in Lake Superior water are killed in a few days by an 0.5 mg/l concentration; mayflies, stoneflies, and caddisflies are killed at 16 to 64 mg/l concentrations.

II. SPECIFIC CONSIDERATIONS: Because of lead's low solubility in comparison with many other metal salts, pH and calcium-magnesium content of water are particularly important in determining its toxicity. High lead concentrations are particularly significant in the soft water of Lake Superior.

III. EXISTING CONDITIONS. The average concentration of lead in filtered water at the St. Mary's River over the five year period ending September 30, 1967 was 0.006 mg/l. Two filtered samples taken at Duluth during this period contained 0.007 and 0.02 mg/l. The average of 20 unfiltered samples taken at scattered sites in Lake Superior during 1967 is 0.027 mg/l. This figure excludes one very high and probably incorrect value of 0.306 mg/l that was found in a sample taken near the center of the lake.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The Public Health Service Drinking Water Standard of 0.05 mg/l should never be exceeded and 90% of the measurements should be less than 0.03 mg/l at any single location.

V. REFERENCES.

1. McKee, J.E., and Wolf, H.W., Water Quality Criteria, Publication No. 3-A, California State Water Quality Control Board, Second Edition, 1963.

2. Pickering, Q.H., and Henderson, C., 1966. The Acute Toxicity of Some Heavy Metals to Different Species of Warmwater Fishes. Air-Water Pollution International Journal 10:453-463.

3. Warnick, S.F., and Bell, H.L., 1969. The Acute Toxicity of Some Heavy Metals to Different Species of Aquatic Insects. Journal of Water Pollution Control Federation. 41:280-284.

4. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C. April 1968.

5. U.S. Department of Health, Education and Welfare, 1962, Public Health Service Drinking Water Standards, PHS Publication No. 956.

NICKEL

I. BIOLOGICAL EFFECTS. The U.S. Public Health Service Drinking Water Standards do not place any concentration limits on nickel. It is a nonessential element, and its toxicity to mammals appears to be very low. However, nickel may be very toxic to some plants.

The lethal concentration of nickel in soft water (20 mg/l hardness) to the fathead minnow is about 5 mg/l and in hard water (360 mg/l hardness) it is about 43 mg/l. With continuous-flow testing the lethal concentration is 20 mg/l in water of 200 mg/l hardness. Using these data, the estimated lethal concentration in Lake Superior water (44 mg/l hardness) would be 7 mg/l of nickel. Some Lake Superior fish are more sensitive, however.

In a long-term bioassay conducted with a water of 200 mg/l hardness at the Federal Water Pollution Control Administration's Newtown Fish Toxicology Laboratory, the "safe" concentration was 0.4 mg/l nickel. At this concentration the fathead minnow lived, grew, and reproduced.

II. SPECIAL CONSIDERATIONS. Certain environmental variables affect toxicity of nickel, but toxicity is not affected by hardness as much as for other metals. Various types of aquatic life differ considerably in sensitivity to nickel.

III. EXISTING CONDITIONS. Concentrations of nickel in the Western Great Lakes Basin were found in 9% of the samples. In the samples with positive occurrence, the mean concentration was 0.01 mg/l and the maximum concentration was 0.028 mg/l. Nickel was not detected at Duluth.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. Nickel should not exceed a maximum of 0.03 mg/l and 90% of the values should be less than 0.015 mg/l at a single location.

V. REFERENCES.

1. Pickering, Q.P. and Henderson, C., Acute Toxicity of Some Heavy Metals to Different Species of Warmwater Fishes, Proceedings 19th Industrial Waste Conference, Purdue University, 1965.

ZINC

I. BIOLOGICAL EFFECTS. Zinc is one of several heavy metals occurring almost universally in surface waters. These natural levels of zinc vary greatly and are influenced by minerals in soils and characteristics of the water itself. Zinc is an essential trace metal for aquatic life, yet inhibits fish production at quite low concentrations.

Long-term tests with the fathead minnow in which the fish were continuously exposed to a series of zinc concentrations during the entire life cycle indicate that concentrations significantly inhibiting reproduction are much lower than the lethal concentrations or those that have demonstrated some histological or physiological changes. These studies were conducted in water with higher calcium, magnesium and pH than that found in Lake Superior water and therefore zinc was less toxic under the test conditions. A decrease in reproduction occurred at a zinc concentration of 0.045 mg/l in hard water. Since the test was conducted in a harder water than that of Lake Superior and the toxicity of zinc increases as the calcium-magnesium level decreases, the safe level in Lake Superior is lower than 0.045 mg/l. Zinc partially reduces reproduction over a wide range of concentrations and there is no sharp threshold.

II. SPECIAL CONSIDERATIONS. Many environmental variables affect the toxicity of zinc. Principal examples would be the calcium-magnesium content of the water, pH, temperature, and differential sensitivity of aquatic species. Such factors prohibit the selection of a single criterion for all freshwater environments.

III. EXISTING CONDITIONS. The mean zinc concentration in water taken at the Duluth, Minnesota, water treatment plant was 0.009 mg/l and at the St. Mary's River, 0.020 mg/l. The current permissible level of zinc in public water supplies is 5 mg/l. The high values recorded in St. Mary's River are of concern.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. Zinc concentrations should not exceed 0.015 mg/l and 90% of the values should be less than 0.010 mg/l. **Additional Committee Recommendation:** *Existing levels of zinc in the St. Mary's River are greater than those proposed and are cause for concern. Every effort should be made to eliminate sources of zinc.*

V. REFERENCES.

1. Brungs, W.A. Chronic Toxicity of Zinc to the Fathead Minnow (Pimephales Promelas, Rafinesque). Transcription American Fisheries Society, April 1969.
2. Mount, D.I. The Effect of Total Hardness and pH on Acute Toxicity of Zinc to Fish. Air and Water Pollution International Journal, 10:49-56 (1966).
3. Skidmore, J.F. Toxicity of Zinc Compounds to Aquatic Animals, with Special Reference to Fish. The Quarterly Review of Biology, 10 (3): 227 (Sept. 1964).
4. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C. April 1968.

CYANIDE

I. BIOLOGICAL EFFECTS. Cyanide is a highly poisonous chemical and occurs principally from industrial processes. It combines with hemoglobin in blood, forming a rather stable complex, and reduces the oxygen-carrying capacity of the blood. It is poorly removed by normal water treatment processes.

Experiments with trout and bluegills resulted in total kill at 0.05 mg/l and other adverse effects as low as 0.005 mg/l.

The U.S. Public Health Service Drinking Water Standard is 0.2 mg/l and the desirable concentration is virtually zero.

II. SPECIAL CONSIDERATIONS. Cyanide toxicity to aquatic life forms is highly pH dependent. Undissociated hydrocyanic acid is most toxic and this is present in the largest proportion at low pH values. It combines readily with heavy metals and may be more or less toxic than the uncombined form, depending on the particular complex.

III. EXISTING CONDITIONS. Average concentrations at both Duluth and the St. Mary's River are less than 0.001 mg/1.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The maximum concentration should not exceed 0.004 mg/l and 90% of the values should be less than 0.002 mg/l at any location.

V. REFERENCES.

1. Biology of Water Pollution, U.S. Department of the Interior, Federal Water Pollution Control Administration, 1967.

2. U.S. Department of Health, Education and Welfare, 1962, Public Health Service Drinking Water Standards, PHS Publication No. 956.

3. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C. April, 1968.

4. Cairns, John. Notulae Naturae, #361, July 30, 1963.

5. Doudoroff, P. Transactions of the American Fishery Society, Vol. 95, No 1, Jan. 1966.

HYDROGEN SULFIDE

I. BIOLOGICAL EFFECTS. Sulfides in water are the result of natural processes of decomposition in enriched waters, sewage, and industrial wastes such as those from oil refineries, tanneries, pulp and paper mills[1] chemical plants, and gas manufacturing facilities. Sulfides are produced by the action of anerobic organisms on sulfates and organic sulphur compounds. Hydrogen sulfide contributes to taste and odor of water supples that can be detected by man at 0.005 - 0.010 mg/1[2] and taints flesh of aquatic organisms.

Experiments with eggs and fry of trout, walleye, northern pike, suckers, and immature blue gills and fathead minnows indicate lethal concentrations of undissociated hydrogen sulfide to vary between 0.008 - 0.058 mg/1[2]. Trout fry are killed in three days at 0.020 mg/1 at high oxygen levels. Freshwater shrimp are more sensitive than fish fry.

II. SPECIAL CONSIDERATION. Hydrogen sulfide decays exponentially with a half life of one hour in oxygenated water.[3] However, it can be evolved into oxygenated water from organic deposits and can be found at lethal concentrations at the bottom-water interface.[1] The toxicity of an effluent may bear no relation to its potential toxicity in organic deposits. Fish eggs, fry, and food organisms are most susceptible. Since most species of sport and commercial value in Lake Superior spawn at depths of 100 fathoms or less,[4] it is important that good water quality be maintained to this depth at the bottom-water interface.

Fish fry are more sensitive to hydrogen sulfide at low oxygen concentrations.[2] The toxicity of sulfide increases markedly with a decrease in pH because there is more undissociated hydrogen sulfide present.

III. EXISTING CONDITIONS. No measurements of dissolved sulfide have been recorded for Lake Superior, however, it is unlikely that any accumulation has occurred since high oxygen levels are found even at 250 meters.

IV. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The recommended criteria is a maximum of 0.02 mg/1 and 90% of the values less than 0.002 mg/1 as total sulfide measured at the bottom-water interface.

V. LITERATURE CITED.

1. Colby, Peter J., and Smith, Lloyd L., Jr., 1967. Survival of Walleye Eggs and Fry on Paper Fiber Sludge Deposits in Rainy River, Minnesota. Transactions American Fisheries Society 96 (3) 278-296.
2. Unpublished Data, Department Entomology Fish and Wildlife, University of Minnesota, St. Paul.
3. Hayes, F. R., Reid, B. L. and Cammeron, M. L. 1958. Lake Water and Sediment. II. Oxidation-Reduction Relations at Mud-water Interface. Limnology and Oceagrophy 3: 308-317.
4. Unpublished Data, Bureau of Commercial Fisheries, Ashland, Wisconsin.
5. Longwell, J. and Pentelow, F.T.K. 1935. The Effect of Sewage on Brown Trout (Salmo trutta L.) Journal Exp. Biology 12: 1-12.

TASTE

I. GENERAL CONSIDERATIONS. Tastes and odors affect principally municipal water supplies and beverage industries. In places, tainting of fish flesh occurs and causes impairment of the water for fish production. Great expense is incurred at some treatment plants in other areas of the country because activated carbon treatment is needed to remove tastes and odors.

II. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. **Committee Recommendation:** *In order to avoid expensive water treatment in the future and to protect fishery resources substances causing taste should not be permitted. Chloroform extracts should not exceed a maximum of 0.05 mg/l and 90% of the values should be less than 0.03 mg/l. No discharge that will produce an off-flavor in drinking water nor impart a taint to fish flesh will be permitted.*

III. REFERENCES.

1. U. S. Department of Health, Education and Welfare, 1962, Public Health Service Drinking Water Standards, PHS Publication No. 956.
2. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D. C. April 1968.
3. Microbiology for Sanitary Engineers. McKinney. 1962.
4. Duluth Municipal Water Supply. Ten Year Composite Log Annual Reports. Duluth, Minnesota. 1968.
5. Quality of Waters, Minnesota - a Compilation - Taste and Odor, 1955 - 1962, State of Minnesota, Department of Conservation, Division of Waters, Bulletin 21, June 1963.

TEMPERATURE

I. GENERAL CONSIDERATIONS. Temperature affects all physical, chemical, and biological processes in Lake Superior. If the normal temperature regime is altered the complete balance of the lake will be changed. An increase in temperature is known to accelerate the aging process of lakes, increase the toxicity of chemicals, lower dissolved oxygen levels, increase algal growths, disrupt delicate biological cycles, and endanger many important sensitive organisms.

Increases in the water temperature of Lake Superior will require more stringent water quality standards for other parameters.

II. BIOLOGICAL EFFECTS. The valuable lake trout, herring and whitefish of Lake Superior require cold water for their survival. Complete mortality of developing embryos is known to occur at 12°C (54°F.). Significant reduction in hatch occurs above 60°C (43°F.) among the coregonid fishes. Most of the important fish in Lake Superior spawn in the fall (Oct., Nov., Dec.) in response to falling temperatures, requiring temperatures of about 10°C (50°F.) or less to initiate the response. Incubation of the eggs which are found on the lake bottom is best below 6°C (43°F.). Optimum incubation occurs at 0.5°C (33°F.) for the lake whitefish (Coregonus clupeaformis) and 2°C (36°F.) or less for the lake herring (C. artedi). Upon hatching in the spring the young fish move into surface waters and at this time exhibit greater temperature tolerance than the incubating eggs. Exposure to temperatures of 15°C (59°F.) will be tolerated by lake herring fry for extended periods without increased mortality rates. Temperature between 18 - 21°C (64-70°F.) will be tolerated for lesser periods but extended exposure to these temperatures increases rate of mortality markedly.

III. SPECIAL CONSIDERATIONS.

A. Heated effluents should not contribute to temperatures of water so as to cause them to serve as barriers to the movement of anadrumous fish to and from their spawning and rearing areas.

B. Discharge of heated effluents should be to the epilimnion, unless a special study indicates a more desirable discharge point, because the important fish species in Lake Superior are deep water dwellers much of the time.

IV. EXISTING CONDITIONS. Lake Superior is a cold clear, oligotrophic lake. It usually does not exhibit well defined temperature stratification until mid-July and even then the stratification is not uniform from area to area and the thermocline is poorly developed. The lake may mix to great depths and homothermous water around 2°C (36°F.) has been found to occur to depths of 600 ft. The deep water remains near 4°C (39°F.) through the year. Yearly average temperatures from Duluth and St. Mary's River are 8.5°C (47°F.) and 7.3°C (45°F.).

Nine year average temperatures at St. Mary's River, given as quarterly averages are:

			Average of Quarterly Mean	Average of Quarterly Maximum
I.	(Jan., Feb., Mar.)	-	0.7° C (33° F)	2.3° C (36° F)
II.	(Apr., May, June)	-	5.5° C (42° F)	14.9° C (59° F)
III.	(July, Aug., Sept.)	-	16.0° C (61° F)	20.4° C (69° F)
IV.	(Oct., Nov., Dec.)	-	7.0° C (45° F)	13.8° C (57° F)

Average temperatures along the North Shore and mid-lake are below these temperatures while averages for areas along the South Shore (Calumet, Marquette, etc.) are similar and occasionally somewhat higher.

These are the maximum values for Lake Superior obtained from the literature as referenced.

I.	(Jan., Feb., Mar.)	-	Mean	1.3° C	(34° F)	Soo (St. Mary's R.)	1965 NWQN
			Max.	2.8° C	(37° F)	Marquette	1954 Beeton
II.	(Apr., May, June)	-	Mean	6.8° C	(44° F)	Soo (St. Mary's R.)	1964 NWQN
			Max.	17.2° C	(63° F)	Calumet	1955 Beeton
III.	(July, Aug., Sept.)	-	Mean	17.9° C	(64° F)	Soo (St. Mary's R.)	1966 NWQN
			Max.	25.0° C	(77° F)	Calumet	1953 Beeton
IV.	(Oct., Nov., Dec.)	-	Mean	7.6° C	(46° F)	Soo (St. Mary's R.)	1963 NWQN
			Max.	13.9° C	(57° F)	Calumet	1953 Beeton

V. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. **Committee Recommendation:** *There shall be no material increase in the temperature of the open water of Lake Superior. Appropriate numerical values for temperature will be established at a later date from values obtained by additional sampling.*

VI. REFERENCES.

1. Beeton, A.M., Johnson, J.H. and Smith, S.H., 1959. Lake Superior Limnological Data. U. S. Fish and Wildlife Service Special Science Report - Fisheries No. 297, Washington, D. C., 177 pp.
2. Breeder, C. M. Jr., and Rosen, D. E., 1966. Modes of Reproduction in Fishes, American Museum of Natural History, Garden City, New York.
3. Dryer, W.R., 1966. Bathymetric Distribution of Fish in the Apostle Island Region of Lake Superior. Transactions of American Fisheries Society. 95 (3): 248-259.
4. National Water Quality Laboratory: Thermal Studies, 1966-1969. Unpublished Data.
5. National Water Quality Network (1957-1968) Annual Compilation of Data. (Storet Retrival System). U. S. Department of Health, Education and Welfare, Washington, D. C.
6. Price, John W., 1940. Time-temperature Relations in the Incubation of the Whitefish, Coregonus clupeaformis (Mitchill). Journal General Physics (4) 23: 449-468.
7. Ruschmeyer, O.R. and Olson, T.A., 1958. Water Movements and Temperatures of Western Lake Superior. School of Public Health, University of Minnesota, for Minnesota Water Pollution Control Commission, 86 pp.
8. Tait, J. S., 1960. The First Filling of the Swim Bladder in Salmonids. Canadian Journal of Zoology. 38: 179-187.
9. Wells, LaRue, 1966. Seasonal and Depth Distribution of Larval Bloaters (Coregonus hoyi) in Southeastern Lake Michigan. Transactions of American Fisheries Society. 95 (4); 388-396.

pH

I. GENERAL CONSIDERATIONS. Most organisms of esthetic and commercial importance live in water within an extremely narrow pH range. The pH concentration is governed by many inorganic chemicals and biological processes. Excessive additions of domestic or/and industrial wastes result in pH changes and can therefore make water unsuitable for desirable organisms. Thus it is important to control pH which in turn will regulate other water quality parameters.

II. BIOLOGICAL EFFECTS. Rudolfs, et. al. (1953) states that a pH range from 6.5 to 8.4 is tolerated by most fish. Chandler (1940) suggests values between 7.5 to 8.4 to be best for plankton production. Ellis (1937) found that most inland waters having fish have pH values between 6.7 and 8.6. Hart, et. al. (1945) report that only 5% of the waters in the United States supporting a good fish population have pH less than 6.7 whereas 95% have a pH less than 8.3. Parsons (1968) found the greatest number of species of plankton, benthos, and fishes to be in stream sections with a pH of 6.8 and above.

Work with pH at the National Water Quality Laboratory suggests that pH values below 6.0 inhibit or reduce spawning success with fathead minnows, and are lethal to Daphnia magna and new Gammarus pseudolimnaeus.

III. SPECIAL CONSIDERATIONS. Permissible criteria for public water supplies given in Water Quality Criteria (1968) give a range of pH from 6.0 - 8.5.

IV. EXISTING CONDITIONS. Lake Superior is an oligotrophic lake low in total dissolved solids and rather poorly buffered. Beeton (1959) gives pH values ranging from 6.9 to 8.0 in 1953 for samples taken at various depths in the open lake; however, most values were between 7.3 and 7.7. The maximum, minimum and mean pH values in Lake Superior were:

	Lake Superior at Duluth	St. Mary's River at Saulte Ste. Marie
Years	1958 - 1968	1960 - 1968
No. Samples	543	457
Maximum	8.5	8.3
Minimum	7.3	6.8
Mean	7.7	7.8

V. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. The pH in Lake Superior should remain between 6.8 to 8.5. **Additional Committee Recommendation:** *The objective is to not allow a trend from existing mean values.*

VI. REFERENCES.

1. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D.C., April 1968.
2. Beeton, A.M., J.H. Johnson, and S.H. Smith, 1959. Lake Superior Limnological Data. U.S. Fish and Wildlife Service Special Science Report -- Fisheries No. 297, Washington, D.C., 177 pp.
3. Chandler, D.C., 1941. Limnological Studies of Western Lake Erie. I. Plankton and Certain Physical-Chemical Data on the Bass Islands Region, from September 1938 to November 1939. Ohio Journal of Science 40, 291.
4. Ellis, M.M., 1937. Detection and Measurement of Stream Pollution (Related principally to fish life)., U.S. Department of Commerce, Bureau of Fisheries Bulletin 22.
5. Hart, W.B., P. Doudoroff, and J. Greenbank. 1945. Evaluation of Toxicity of Industrial Wastes, Chemicals and Other Substances to Freshwater Fishes. Water Control Laboratory, Atlantic Refining Company, Philadelphia, Pennsylvania.
6. Parsons, J.D., 1968. The Effects of Acid-Strip-Mine Effluents on the Ecology of a Stream. Arch. Hydrobiol. 65(1):25-50.
7. Rudolfs, W., et. al. 1953. Industrial Wastes. Reinhold Publishing Company, New York.

RADIOACTIVITY

I. GENERAL CONSIDERATIONS. There are at present no numerical radiological criteria directly applicable to the open waters of Lake Superior. Releases of radioactive materials to the lake (or otherwise) are regulated, however, by license by the Atomic Energy Commission.[1] Concentration of radionuclides in food and water used in interstate commerce, derived from the lake, are regulated by the U. S. Public Health Service. In addition, State and local regulations limit the concentrations permitted in public drinking waters.

The Federal Water Pollution Control Administration has been working with the Atomic Energy Commission and the U. S. Public Health Service to develop model radiological criteria for water. These criteria will apply to receiving waters, as different from waste effluents which are regulated by the Atomic Energy Commission as noted above. These criteria will be composed of three parts designed for the protection of human health as it may be affected through (1) drinking water, (2) waters used for recreation and other purposes involving potential human contact with or ingestion of water, and (3) waters used for the production or processing of food for human consumption (i. e. fish, shellfish, irrigated crops, milk, etc.).

After a draft of the criteria, developed at staff level through the joint effort of these three Federal agencies, has been reviewed and officially endorsed by each agency, it will be submitted to the Federal Radiation Council, the Conference of State Sanitary Engineers and an appropriate organization of the State radiological health officers for review, comments and hopefully, endorsement. This process may require up to a year to complete.

II. EXISTING CONDITIONS. The 12 year average gross beta radioactivity at Duluth is approximately 9.5 picocuries/1, including several years of active atmospheric bomb testing (and accompanying fallout). Radioactivity levels since 1965 have averaged less than 3.5 picocuries/1.

The similar 12 year average for total alpha activity, which includes radium and other naturally occurring radionuclides, is approximately 0.12 picocuries/1.

Similar averages were obtained at the St. Mary's River station.

III. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. **Committee Recommendation:** *Proposed radiological criteria will be deferred pending development of model criteria by Federal Water Pollution Control Administration, Atomic Energy Commission and U.S. Public Health Service. When these model criteria are published an appropriate review will be made at that time to determine their suitability for the open waters of Lake Superior.*

IV. REFERENCES.

1. U. S. Atomic Energy Commission, Part 20: Standards for Protection Against Radiation, Federal Register 25 (224): 10914-10924. November 17, 1960.
2. National Committee on Radiation Protection, Report of Ad Hoc Committee, Somatic Radiation Dose for General Population, Science 131:482. February 19, 1960.
3. Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposures. Handbook No. 69, National Bureau of Standards, Washington, D. C. 1959.
4. Background Material for the Development of Radiation Protection Standards. Staff Report, Federal Radiation Council, Washington, D. C. July 1964.
5. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D. C., April 1968.

ALL OTHER POLLUTANTS

I. GENERAL CONSIDERATIONS. Application factors provide a rational basis for estimating safe concentrations of pollutants utilizing easily obtained lethal values and are especially useful for establishing safe concentrations of mixed effluents. The procedures to be followed in deriving application factors are discussed on pages 58 and 59 of the Report of the National Technical Advisory Committee on Water Quality Criteria and a brief outline follows.

As the report points out, a great difference usually exists between the toxicant concentration that kills in a few days and the concentration that is just barely safe over one or more entire life cycle periods of continuous exposure to the toxicant. An application factor is composed of the ratio or fraction derived by relating, for a given pollutant, the mortality data from a four day toxicity test to the just safe concentration for the entire life cycle. This factor can subsequently be used to estimate environmental concentrations of this toxicant that are safe for different species of fish or in different water types. One does this by multiplying the application factor for the pollutant by the toxicity data obtained from a four day test with the new species or water type. A different application factor must be calculated for each pollutant.

Thus, application factors are important because they eliminate the necessity of having to expose entire life cycles of all species in all water types. They have varied from 1/7 to 1/500 for different pollutants that have been tested.

II. RECOMMENDED CRITERIA FOR LAKE SUPERIOR. In the absence of specific information, safe concentrations of pollutants should be:

1. For nonpersistent pollutants or those that have noncumulative effects, the environmental concentration should not exceed 1/10 of the 96-hour TL_m level at any time or place, and 90% of the measurements should not exceed 1/20 of the 96-hour TL_m value.
2. For other toxicants the environmental concentrations should not exceed 1/20 and 1/100 of the 96-hour TL_m level under the conditions described in (1) above.
3. Proportional reductions should be made in the permissible concentrations of pollutants when they are known to affect or add to the toxicity of other pollutants present in the water.

III. REFERENCES.

1. Water Quality Criteria, Report of the National Technical Advisory Committee to the Secretary of the Interior, Federal Water Pollution Control Administration, Washington, D. C., April 1968.
2. Mount, D.I., and C.E. Stephan. 1967. A Method for Establishing Acceptable Toxicant Limits for Fish--malathion and the butoxyethanol ester of 2, 4-D. American Fish Society, Trans. 96(2): 185-193.

MR. STEIN: Any comments or questions?

MR. BADALICH: Mr. Chairman.

MR. STEIN: Yes.

MR. BADALICH: Is a motion in order at this time?

MR. STEIN: You can make a motion if you wish.

MR. BADALICH: Mr. Chairman, I move that we adopt the recommendations of the water quality criteria committee.

MR. STEIN: All right.

MR. BADALICH: As stated on page number 7 of their report.

MR. STEIN: O. K. I have a few questions before you adopt that. That motion will be in order.

This is no criticism of you, Mr. Fetterolf, but someone asked once what a camel was and was told that it was a horse created by a committee.

I notice when we get to page 3 here, it talks about water quality criteria on public water supply and cold water fishery. It says that the problem of zinc criteria as established in public water supply would be 5 mg/1 maximum allowable concentration.

Yet such a concentration would be fatal to most aquatic life inhabiting that water body and, therefore, we shouldn't really take this 5 mg/1 if we take a water quality criteria.

We can reverse that with mercury. With mercury it might not be harmful to the fish, but it will be harmful to humans.

What would hurt if we took the most restrictive situation?

MR. FETTEROLF: Nothing would be hurt.

MR. STEIN: All right. I don't see where this problem arises. If you put this in a cold water fishery and you put this for public water supply, we take the criteria or the requirement that is going to protect the use we are going to protect. We don't want to kill fish and we surely don't want to kill people, so I don't see that we have a problem.

MR. FETTEROLF: The Committee wrestled with putting this paragraph in the report or deleting it, but a problem exists where a State has placed a 5 milligram per liter restriction on zinc for drinking water and yet they do not have restrictions for aquatic life, and the restrictions for aquatic life might be based on the results of bioassays done over a long period, but the actual concentration of zinc which would be harmful to aquatic life is not particularly well known. And so while the States did not have particular restrictions on zinc for the protection of aquatic life, they did have restrictions in that would protect human health.

MR. MACKIE: Mr. Chairman.

MR. STEIN: Yes.

MR. MACKIE: We seem to be discussing a motion and it might be in order to have a second to the motion before we go any further in getting on the record.

MR. STEIN: We don't take votes here, but if you want a second, fine. Is there a second?

MR. MACKIE: If the motion is in order, then I think we should discuss it properly.

MR. BADALICH: Is this a new procedure, Mr. Stein, or what?

MR. STEIN: No, this is not a new procedure.

MR. BADALICH: Oh, I see.

MR. STEIN: This is not a new procedure. Each State speaks for itself and we try to arrive at a consensus and we don't take votes here because the Secretary makes the judgment at the end.

MR. BADALICH: Oh, that is right.

MR. STEIN: Now, if you think when we have got three States here we are going to be outvoted, you can try this and we will put it on the record.

MR. BADALICH: Are you afraid of that, Murray, or what? (Laughter.)

MR. STEIN: No, I am not afraid of that. But I would like the facts to come out for the people to see what you are voting for here and then when you want to vote for it, that is great. I don't need a second, but you can vote for this if you want. (Laughter.)

Do you want a second?

MR. BADALICH: Well, whatever might be in order here, Mr. Chairman.

MR. STEIN: We don't need a second to take this up, but if you want a second we will be delighted to have one. (Laughter.)

MR. BADALICH: Do I take it, Mr. Stein, that we are going to concur in this thing unanimously so we don't have to have a motion? Is that it?

MR. STEIN: No, if you are going to concur in this unanimously, I am going to need a little convincing.

MR. BADALICH: I see.

Well, Mr. Chairman, am I recognized?

MR. STEIN: Yes. How can I help it? (Laughter.)

MR. BADALICH: Thank you.

Regarding the last statement on the multiple use, I see no conflict, as far as that goes, in the State of Minnesota. We have adopted multiple use on many of our streams and lakes and rivers, and so on, and any time that there is a difference in the parameters being used we always do go along with the most stringent.

So in this case, in the illustration that Mr. Fetterolf brought forth here on the zinc, our classification is more restrictive on the aquatic life, so then in turn--I mean on aquatic organisms--so then in turn we would apply the fisheries classification to this instead of the--

MR. STEIN: Yes.

MR. BADALICH: --Public Health Service as far as drinking water supply is concerned.

MR. STEIN: As far as I understand, with the three States involved here and the Federal Government, we all adopt the same rule, and I am shocked that the Committee should even bring this up as an issue, because we haven't had this problem for years. I know Minnesota does this; I know the other States do this--that where we have to protect fishlife and where we have to protect human life we adopt the most restrictive to protect the maximum number of water users.

In no way should this be construed as a criticism on my part of the States programs, because since 1940 the States have been,as far as I can see, 20 years ahead of this report in their operations. Whenever they have a more restrictive use, they have no problems in requiring the more restrictive requirement.

But my main point goes to the next one. I see the committee did a tremendous job and I would like to read this sentence. It says:

"Because data were not available to completely assess"--the committee did one thing. They may not have split the atom, but they split an infinitive--"to completely assess existing quality in the lake and because the existing standards include nondegradation clauses, the committee concluded it was not appropriate to recommend new water quality criteria for establishment as standards for the open waters at this time." And then they indicated that they were proposing guidelines.

Well, we have been over this guideline business, up and down, and I think you have heard from the citizens this morning. I think what we are asking for, and for which we have a legal requirement set by the Federal Government, is to set water quality standards that we are going to regulate. And if all we can come up with is guidelines for an indication that these aren't quite sufficient because we don't have enough data yet, we can't use them as standards.

Yet if you want to adopt this, this is great; I will be glad to accept the motion.

MR. PURDY: Mr. Stein.

MR. STEIN: Yes.

MR. PURDY: I have one question that I would like to ask Mr. Fetterolf, and this relates now to the matter of considering a guideline or criteria for the most restrictive use.

Mr. Fetterolf, in Table 1, now, are the values recommended by the Committee those that the Committee deemed necessary for the most restrictive need?

MR. FETTEROLF: Yes, they are.

MR. STEIN: Then why can't you accept them as a criteria or a requirement? What is this guideline recommendation we have? What do we do with that?

In other words, a State can look at this and if they like it they can use it, or we can use it, and if we don't, we can't. Is that what the Committee has given us and that is what you want to adopt? Maybe this is a giant step forward, like the first guy on the moon.

MR. PURDY: Mr. Stein, under what provisions can this conference adopt water quality standards for the States?

MR. STEIN: Under this conference we can recommend those and the Committee can put these forward as a recommendation. But, as far as I can see, they are saying that they have insufficient data and they are just putting these forward as a guideline. Once you come up with requirements and you say that it is supported by insufficient data, I think you have damned it by such faint praise you put us on a real rack if we are going to adopt these as a requirement. Either you have the data to recommend it or you don't.

Now, what did this Committee do?

MR. PURDY: It would seem that we have the report and recommendations of the Committee and they state this.

MR. STEIN: Yes, we do. Do you want to adopt this for the conferees? I will be glad to entertain it.

MR. MACKIE: Mr. Chairman, I will second the motion made by Mr. Badalich.

MR. STEIN: O. K.

Do all the conferees want to adopt this report as guidelines?

MR. PURDY: Well, Mr. Stein, I for one have received this report to review for the first time about 5 minutes ago, even though I had representatives on this Committee. I would like the opportunity of studying the report and reviewing it in detail now with my representatives that were on the Committee.

MR. STEIN: Right. Well, Mr. Purdy, for myself, I didn't get the report a minute before you did.

Are there any other comments?

Do we want to defer that on Mr. Purdy's

comment that he needs more time to review?

MR. MAYO: Mr. Chairman, in the face of Mr. Purdy's comment and his concern about the need for the State of Michigan to have additional time, I would like to suggest to Mr. Badalich that he, and his second, consent to the withdrawal of the motion.

MR. STEIN: Is this agreeable?

MR. BADALICH: Mr. Chairman.

MR. STEIN: Yes.

MR. BADALICH: Mr. Mayo, could you specify some time there that you would want for review? Because I think this is a very important matter and I think that we should probably take some definitive action on this.

MR. STEIN: Let me tell you, I don't think we should, and I can give you a time for review. You will recall, Mr. Badalich, that at the first sessions of the conference we said that the six months legally would run from the time we issued the summary.

MR. BADALICH: Yes, that's right.

MR. STEIN: These six months, as I understand it from looking at the papers as served and mailed, will not be up until the end of July. Is my understanding correct?

Therefore, I think if this is the case, after that date at the very earliest point in August might be the time to consider this.

Will this be agreeable?

MR. BADALICH: Well, Mr. Chairman, I would be willing to withdraw my motion providing that we do take this up at the next scheduled reconvening of this conference.

MR. STEIN: Right.

MR. BADALICH: Which will be after July 26 of this year.

MR. STEIN: That is correct.

MR. BADALICH: All right, I will agree to that.

MR. STEIN: All right, then we are in agreement.

Are there any other comments or questions?

This will be a prime issue at that time.

MR. MAYO: Mr. Chairman, I would like to raise the point with the other conferees and ask them if they feel it would be appropriate to address themselves to these recommendations in the context of suggested standards rather than only as recommended criteria at that time. I would like some comment from them on that point.

MR. STEIN: Do you want it right now?

May I make a suggestion to you, Mr. Mayo? I think you asked a very pertinent question and it certainly seems we are going until tomorrow. Would you agree that we should give the conferees time to consult with their staffs and look at this and possibly come up with an answer if they want to answer it tomorrow?

MR. MAYO: Fine. Fine.

MR. STEIN: O. K.

Are there any further comments or questions?

MR. BADALICH: Mr. Chairman.

MR. STEIN: Yes.

MR. BADALICH: I think the State of Minnesota would not be adverse to this. Actually these criteria as proposed here are fairly comparable to our standards, but you have to realize that under statutory procedure as far as States are concerned we will possibly have to hold a public hearing to ratify these standards if there is any deviation from what has been accepted now through our normal course of hearings.

MR. STEIN: Mr. Badalich, I thoroughly agree with you. I couldn't agree with you more. But instead of a committee setting a standards criteria regulation, we have one damning us with faint praise, by saying, "Because data were not available to completely assess"--I keep going over that split infinitive all the time--"to completely assess existing quality in the lake and because the existing standards include nondegradation clauses, the committee concluded it was not appropriate" the only thing I am asking for is, if we are confident enough of this, maybe we should remove the disclaimer.

MR. BADALICH: Well, I think that these criteria were actually developed as guidelines to the State agencies as well as to the Federal Government to adopt this as future water quality standards. And we certainly will follow this intent of the Committee to make any modification in our standards to be conducive or, should I say, comparable to what has been proposed.

MR. STEIN: I think we are very close on this. You see, if the committee puts this forward and says the reason they can't adopt these as standards is "because data were not available to completely assess existing quality," then presumably if one follows the recommendation of the committee, we need considerably more data in order to accept these as standards.

The question that I have is: Haven't they done enough work to give us a judgment whether we can adopt these as standards or not? When one talks about this endless study operation, any time a group comes out and says, and I quote again, "because data were not available to completely assess," I think one can say that about anything. The time has come when we go into production. Are we going to have a standard or are we not going to have a standard? (Applause.)

MR. PURDY: Mr. Stein.

MR. STEIN: Yes.

MR. PURDY: It would seem to me that one of the difficulties in this area would be what the standard proposes to do. Now, if, say, these standards are recommended on the basis that this is the water quality that is necessary to protect a particular use, then possibly we can go to the literature and determine what that standard ought to be and, in fact, have ample information to do this.

It is my understanding, though, that some of these standards are based upon the desire to maintain the Lake Superior water quality in its present state, and the problem there is the absence of information of the present quality of the Lake Superior waters.

MR. STEIN: All right. That is why I think you should have until tomorrow to consider this.

But, it seems to me, if we have an antidegradation clause in it, and we are talking about when water quality in Lake Superior is above any existing standards we won't degrade it; if this is the issue; if this is what we are saying and we agree on that in principle--then we can go out and analyze the quality of the waters subsequent to that statement of policy, find out what it is and keep those waters up to that. That is one thing.

MR. PURDY: When I review with my representatives on the Committee, I think this is one of the problems that we are discussing right at the moment.

MR. STEIN: Right. By the way--and I want to say this to the audience--this is not a very simple problem. I think we probably can use all the time between now and the end of July. It may or may not have been fortuitous, but we will need it to examine this. But you make a determination tomorrow how closely you want to commit yourselves now, because our present intention is to reconvene the conference early in August (after that July date has run and the legal date has run) to come up with these conclusions. In view of the complex problems with which we are confronted here, you may want to consider until tomorrow how we set this forward. But I would recommend when you consider this that you don't tie yourselves down or make any premature judgments on this issue.

Mr. Purdy, I stand with you on this. I don't think that given this material that you can make a very rapid judgment on it.

Are there any other comments or questions?

If not--

MR. FETTEROLF: Mr. Stein.

MR. STEIN: Yes.

MR. FETTEROLF: In the charge to the committee from the conferees it states, "The purpose of the committee is to develop particular water quality criteria as guidelines for modification of the Federal-State water quality standards."

And in one of our recommendations we suggest that these water quality guidelines be considered by the States as standards. There are some that could perhaps be considered now as standards and there are others that do need further work.

MR. STEIN: O. K. Then maybe we are dealing with a literary operation and you don't mean a disclaimer-- you don't mean to disclaim all these for inadequate data. In other words, you are suggesting that a considerable portion of these you would recommend, on the committee's recommendation, be adopted as criteria and standards right now? Some of them you are not so sure of?

MR. FETTEROLF: We could recommend that some of them be considered by the various States for adoption as standards at this time.

MR. STEIN: Right. O. K.

I think again we should go through those rather carefully--and this is just a suggestion--with the States before we come to our next one, make a judgment, and recommend to your State agencies those which you believe can be adopted and those which you believe need further work. Let's see what the States say, because we are probably closer to the goal line than we imagine.

Let me tell you this. Substantively I think your work is great.

MR. FETTEROLF: So do we. (Laughter.)

MR. STEIN: I wish you would have more confidence in this and put it forward for something for adoption.

MR. FETTEROLF: If the United States Government and the various States supplied the funding for the gathering of information it could be substantially done.

MR. STEIN: Oh. (Laughter.) I wish we would come up with another answer of why we don't do anything other than, "If only the Federal Government would supply the funding, we would do it." There has got to be another excuse. (Laughter.)

MR. FRANGOS: Mr. Chairman.

MR. STEIN: Yes.

MR. FRANGOS: We, I think, generally concur with the direction that this whole discussion has taken; and I think basically our position is that we ought to adopt whatever standards we find that we can agree on and do it as soon as we can.

MR. STEIN: Thank you very much, Mr. Frangos. (Applause.)

Mr. Mayo.

MR. MAYO: The next presentation will be given by Mr. Merrill Gamet of the Federal Water Quality Administration Regional Office--The Summary of Waste Treatment and Disposal Facilities at Federal Installations.

MERRILL GAMET, CHIEF
FEDERAL ACTIVITIES COORDINATION BRANCH
GREAT LAKES REGION, FEDERAL WATER QUALITY
ADMINISTRATION
U. S. DEPARTMENT OF THE INTERIOR
CHICAGO, ILLINOIS

MR. GAMET: Mr. Chairman, conferees, ladies and gentlemen.

My name is Merrill Gamet. I am Chief of the Federal Activities Coordination Branch, Great Lakes Region, Federal Water Quality Administration.

M. Gamet

This report is made of accomplishments that have been made toward abatement of pollution at Federal installations in the Lake Superior Basin, and I would like to refer to each installation which was given consideration here case by case.

The U. S. Air Force:

Calumet Air Force Station. Additional 30,000 GPD contact stabilization treatment plant plus chlorination was completed and placed in operation in October 1969.

K. I. Sawyer Air Force Base. Modification, expansion and improvement of existing secondary treatment facilities were completed and became operable in November 1969. A request for funds to provide for nutrient reduction will be submitted by June 30, 1970. The USAF Regional Environmental Health Laboratory will conduct pilot studies to obtain design criteria. The tertiary treatment facilities will be completed or under construction by December 1972.

Finland Air Force Station. Contact stabilization treatment facilities plus chlorination were completed and placed in operation in June 1969.

Duluth Air Force Missile Site. Sanitary wastes are treated in an extended aeration plant without chlorination. Fiscal year 1971 funds will be requested to provide chlorination, or to connect to the municipal system. The station has been informed of the May 1970 deadline for chlorination and advised that immediate interim remedial measures be taken to install temporary facilities until such time as a final decision is made and project completed.

Minnesota Air National Guard, Duluth. Connection of the sanitary sewer system to the Duluth municipal system was completed in October 1969.

U. S. Forest Service:

Clark-Helen Day Use Area-Sylvania Campground, Ottawa National Forest. Construction of sewer system, aerated lagoon, spray irrigation and chlorination in progress. Completion, summer 1970.

Kenton Dwellings, 1, 2 & 3, Ottawa National Forest. Project to connect sanitary waste system to the municipal system. Projected completion date, fall 1970.

Black River Campground, Ottawa National Forest. Design for aerated lagoon and irrigation system has been completed. Projected project completion, summer 1971.

Tofte Administrative Site, Superior National Forest. Project to install secondary treatment, subsurface sand filtration, and chlorination has been completed.

White Face Reservoir Campground, Superior National Forest. Fiscal year 1971 funds will be requested for a sewer system, aerated lagoon, spray irrigation and chlorination. Estimated project completion summer 1972.

Two Lakes Campground, Chequamegon National Forest. Preliminary plans have been completed to install a waterborne system with aerated lagoon, irrigation and disinfection. Fiscal year 1971 funds will be requested with projected completion date by December 1972.

U. S. Coast Guard:

Duluth Entrance Harbor Light Station. Station has secondary treatment plus chlorination, but it is proposed that this station be unmanned and automated in 1971.

Bayfield Station, Bayfield, Wisconsin. Station is manned by one person on an intermittent basis and is equipped with an incinerator type toilet. An office trailer with sanitary tie to the existing city sewer is to be installed in the near future.

M. Gamet

Passage Island Light Station. Existing facilities consist of a 900-gallon septic tank with discharge to Lake Superior. Proposed unmanning 1974 to 1976. No interim plans have been made to comply with conference recommendations. The U S. Coast Guard was advised of the December 1972 deadline.

In addition, for your information this station has a complement of five men.

Rock of Ages Light Station. Station has no treatment. All wastes discharge to Lake Superior. Proposed unmanning 1974 to 1976. No interim plans made to comply, but the Coast Guard has also been advised of the December 1972 deadline. There are five men stationed at this installation also.

U. S. Coast Guard Cutter WOODRUSH stationed at Duluth. Development work is in progress to provide a satisfactory secondary package treatment plant plus chlorination on this vessel. Anticipated completion of installation is prior to December 31, 1972.

U. S. Army, Corps of Engineers:

U. S. Vessel Yard, Duluth. Connection of the sanitary sewer system to the Duluth minicipal sewer system was completed in November 1969.

Two derrick boats, one dredge and three tow boats are equipped with macerator-chlorinators and detention tanks for chlorine contact, followed by overboard discharge. Evaluation is presently in progress of a recirculating-evaporating-holding type toilet. It is presently anticipated that these devices will be approved and will be installed on all of these vessels by or before December 31, 1972.

National Park Service:

Motor Vessel RANGER III, a 165-foot vessel. This is the only passenger-carrying vessel providing service to Isle Royale. It is equipped with adequate holding tank capacity and discharges wastes into the Houghton-Hancock municipal sewer system.

The Tug J. E. COLOMBE. Equipped with a holding tank which is evacuated to a septic tank drainfield system at the Mott Island Headquarters when necessary.

Four 26-foot Motor Vessels. These vessels provide inter-island transportation for National Park Service employees. Portable holding tanks have been recommended for emergency use. These will be provided.

M. Gamet

Department of Justice, Immigration and Naturalization Service:

Border Patrol Station, Grand Marais, Minnesota. Installation of a new lift station, septic tanks, sand and gravel filter, and chlorination facilities was completed during the winter of 1969.

And finally a word about operating reports.

Information has been received that the Department of Defense has initiated steps to liberalize existing regulations regarding the release of operating data for wastewater treatment plants. This will be done in order to assure compliance with the intent of Executive Order wherever possible by recognizing that there may be some limitations in the interest of national defense. Each State will be required by letter to submit to the Regional Office a list of facilities from which operating records are desired. These operating records will be submitted to the appropriate Regional Office and forwarded to the requesting State.

This is the end of my report.

(The foregoing report with its attached tables is as follows:)

SUMMARY OF WASTE TREATMENT AND DISPOSAL AT FEDERAL INSTALLATIONS WITH SURFACE WATER DISCHARGES IN THE LAKE SUPERIOR BASIN

(More detailed information is given in the status report that has been distributed to the conferees.)

This report has been prepared for presentation at the reconvened session of the Lake Superior Enforcement Conference, Duluth, Minnesota, April 29,30, 1970. We are pleased to report on the accomplishments that have been made toward abatement of pollution at Federal installations in the Lake Superior Basin.

U.S. AIR FORCE:

1. Calumet Air Force Station - Additional 30,000 GPD contact stabilization treatment plant plus chlorination was completed and placed in operation in October 1969.
2. K. I. Sawyer Air Force Base - Modification, expansion and improvement of existing secondary treatment facilities were completed and became operable in November 1969. A request for funds to provide for nutrient reduction will be submitted by June 30, 1970. The USAF Regional Environmental Health Laboratory will conduct pilot plant studies to obtain design criteria. The tertiary treatment facilities will be completed or under construction by December 1972.
3. Finland Air Force Station - Contact stabilization treatment facilities plus chlorination were completed and placed in operation in June 1969.
4. Duluth Air Force Missile Site - Sanitary wastes are treated in an extended aeration plant without chlorination. FY 1971 funds will

be requested to provide chlorination, or to connect to the municipal system. The station has been informed of the May 1970 deadline for chlorination and advised that immediate interim remedial measures be taken to install temporary facilities until such time as a final decision is made and project completed.

5. Minnesota Air National Guard, Duluth - Connection of the sanitary sewer system to the Duluth municipal system was completed in October 1969.

U.S. FOREST SERVICE:

1. Clark-Helen Day Use Area-Sylvania Campground, Ottawa National Forest - Construction of sewer system, aerated lagoon, spray irrigation and chlorination in progress. Completion, summer 1970.
2. Kenton Dwellings, 1, 2 & 3, Ottawa National Forest - Project to connect sanitary waste system to municipal system. Projected completion date, Fall 1970.
3. Black River Campground, Ottawa National Forest - Design for aerated lagoon and irrigation system has been completed. Projected project completion summer 1971.
4. Tofte Administrative Site, Superior National Forest - Project to install secondary treatment, subsurface sand filtration and chlorination has been completed.
5. White Face Reservoir Camp Ground, Superior National Forest - FY 1971 funds will be requested for a sewer system, aerated lagoon, spray irrigation system, and chlorination. Estimated project completion summer 1972.

6. Two Lakes Campground, Chequamegon National Forest - Preliminary plans have been completed to install a waterborne system with aerated lagoon, irrigation and disinfection. FY 1971 funds will be requested with projected completion date by December 1972.

U.S. COAST GUARD

1. Duluth Entrance Harbor Light Station - Station has secondary treatment plus chlorination, but it is proposed that the station be unmanned and automated in 1971.
2. Bayfield Station, Bayfield, Wisconsin - Station is manned by one person on an intermittent basis, and is equipped with an incinerator type toilet. An office trailer with sanitary tie to the existing city sewer is to be installed in the near future.
3. Passage Island Light Station - Existing facilities consist of a 900-gal. septic tank with discharge to L.Superior. Proposed unmanning 1974-76. No interim plans have been made to comply with conference recommendations. The USCG was advised of the Dec. 1972 deadline.
4. Rock of Ages Light Station - Station has no treatment. All wastes discharge to L.Superior. Proposed unmanning 1974-76. No interim plans have been made to comply but USCG was advised of Dec. 72 deadline.
5. USCG Cutter WOODRUSH, Duluth - Development work is in progress to provide a satisfactory secondary package treatment plant plus chlorination on this vessel. Anticipated completion of installation is prior to December 31, 1972.

U.S. ARMY, CORPS OF ENGINEERS:

1. U.S. Vessel Yard, Duluth - Connection of the sanitary sewer system to the Duluth municipal sewer system was completed in November 1969.
2. Two derrick boats, one dredge and three tow boats are equipped with macerator-chlorinators and detention tanks for chlorine contact, followed by overboard discharge. Evaluation is presently in progress of a recirculating-evaporating-holding type toilet. It is presently anticipated that these devices will be approved and will be installed on all of these vessels by or before Dec. 31, 1972.

NATIONAL PARK SERVICE:

1. Motor Vessel RANGER III (165 ft.) - This is the only passenger-carrying vessel providing service to Isle Royale. It is equipped with adequate holding tank capacity, and discharges wastes into the Houghton-Hancock municipal sewer system.
2. Tug J. E. COLOMBE (45 ft.) - Equipped with a holding tank which is evacuated to a septic tank, drainfield system at the Mott Island Headquarters when necessary.
3. Four 26-ft. Motor Vessels - These vessels provide inter-island transportation for National Park Service employees. Portable holding tanks have been recommended for emergency use. These will be provided.

DEPARTMENT OF JUSTICE, IMMIGRATION AND NATURALIZATION SERVICE:

1. Border Patrol Station, Grand Marais, Minnesota - Installation of a new lift station, septic tanks, sand and gravel filter, and chlorination facilities was completed during winter 1969.

OPERATING REPORTS:

Information has been received that the Department of Defense has initiated steps to liberalize existing regulations regarding the release of operating data for waste water treatment plants. This will be done in order to assure compliance with the intent of Executive Order wherever possible by recognizing that there may be some limitations in the interest of national defense. Each State will be requested by letter to submit to the Regional Office a list of facilities from which operating records are desired. These operating records will be submitted to the appropriate Regional Office, and forwarded to the requesting State.

GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

DATE OF SUBMISSION Apr.1970

PREPARED BY

DESIGNATED SOURCE & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	Present Treatment	REQUIRED CONSTRUCTION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	Pop. and/or 1,000 GPD	COMMENTS AND/OR REASON FOR DELAY
MICHIGAN							
U.S. Coast Guard							
Keweenau Lower Entrance Light Station (Houghton Co.)	Lk.Superior	None	Sec. Cl_2	Compl.		11 P	Secondary treatment plus chlorination installed in 1964. No operational problems. Proposed unmanning and automating by 1974-1976.
Eagle Harbor Light Station Eagle Harbor (Keweenaw Co.)	Lake Superior	None	Sec. Cl_2	Compl.		7 P	Secondary treatment plus chlorination installed in 1964. No operational problems. Proposed unmanning and automating by 1974-1976.
Passage Island Light Sta. (Keweenau Co.)	Lk.Superior	3, 2	ST	FI	OO	5 P	Existing facilities consist of a 900-gallon septic tank with discharge to Lake Superior. Proposed unmanning, 1974-76. No interim plans have been made to comply with conference recommendations. The USCG has been advised of the Dec.1972 deadline.
Rock of Ages Light Station (Keweenau Co.)	Lake Superior	3, 2	None	FI	OO	5 P	Station has no treatment. All wastes discharge to L.Superior. Proposed unmanning, 1974-76. No interim plans have been made to comply but USCG was advised of the Dec. 1972 deadline.
Huron Island Light Station West Huron Island (Marquette Co.)	Lake Superior	None	Sec. Cl_2	Compl.		5 P	Secondary treatment plus chlorination installed in 1964. No operational problems. Proposed unmanning and automating by 1974-1976.
U.S. Dept. of Agriculture Forest Service Ottawa National Forest							
Clark-Helen Day Use Area, Sylvania Campground and Recreation Area (Gogebic Co.)	G	3, 2	None	CO	•	150 P	Construction of sewer system, aerated lagoon, spray irrigation facilities plus chlorination in progress. Construction completion date scheduled for summer 1970.

KEY: CONSTRUCTION PHASE
(PP) Preliminary Plans
(FP) Final Plans
(FI) Financing
(CO) Construction

STATUS OF COMPLIANCE
(+) Ahead of Schedule
(•) On Schedule
(O) Behind Schedule (Less than 1 year)
(OO) Behind Schedule (Over 1 year)
(*) Unilateral Extension Given by State

REMEDIAL NEEDS
(1) Sample &/or report
(2) Disinfection
(3) Secondary Treatment or Equivalent
(4) Phosphorus or Nutrient Removal
(5) New or Improved Trt.
(6) Plant Expansion
(7) Reduction, Removal or Neutralization of: Acid, (Cl) Chloride, (Cu) Copper, (CN) Cyanide, (Fe) Iron, (M) Metals, (N) Nitrogen, Oil, (BOD) Oxygen Demand, (Ph) Phenol, (S) Solids, (TO) Threshold Odor,
(8) Connect to Municipal System
(9) Separation or Control of Combined Sewers
(10) Storm Sewer Treatment
(11) Exclude Clear Water
(12) Sewers
(13) Adequate Treatment
(14) Improve Operation
(15) Evaluate Present Facilities
(16) Reduction of All Critical Constituents
(17) Advanced Waste Treatment

(Compl.) Completed
(HT) Holding Tank
(ST) Septic Tank
(DF) Drain Field
(P) Persons

GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

DATE OF INFORMATION Apr.1970
PREPARED BY

DESIGNATED SOURCE & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	Present Treatment	REQUIRED CONSTRUCTION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	Pop. and/or 1,000 GPD	COMMENTS AND/OR REASON FOR DELAY
MICHIGAN, Cont'd.							
U.S. Dept. of Agriculture Forest Service Ottawa National Forest							
Kenton Dwelling No. 1, 2 & 3 (Houghton Co.)	G	3, 2	None	CO	=	1.20	The Forest Service has advertised for bids to connect the dwelling sanitary wastes system to the Kenton sewage treatment facilities. Construction completion date Fall 1970.
Kenton Ranger Station (Houghton Co.)	Ontonagon River Lk.Superior	None	Sec.,sand filter, Cl_2	Compl.	=	0.80	2,000 GPD package treatment plant, sand filter, chlorine contact tank, and chlorination facilities installed in 1966.
Bergland Ranger Station Office, Bergland (Ontonagon Co.)	G	None	ST, DF	Compl.	=	0.20	New septic tank and drain field installed in the summer of 1969.
Black River Campground (Ontonagon Co.) (Boat docking facilities)	G	3, 2	ST	FP, CO	=	12.0	Design for replacing septic tank with aerated lagoon and irrigation system has been completed.. Construction completion date expected by 1971 (summer).
U.S. Air Force							
Calumet Air Force Station Ahmeek (Keweenaw Co.)	Ditch to Creek to Lk.Superior	4	Sec.,Cl_2	Compl.	=	32.0	New contact stabilization package sewage treatment plant (30,000 GPD) plus chlorination installed and placed in operation October 1969. This supplemented the overloaded existing 6,000 GPD plant. State will require nutrient reduction by 1972.

KEY: CONSTRUCTION PHASE
(PP) Preliminary Plans
(FP) Final Plans
(FI) Financing
(CO) Construction

STATUS OF COMPLIANCE
(+) Ahead of Schedule
(=) On Schedule
(G) Behind Schedule (Less than 1 year)
(GG) Behind Schedule (Over 1 year)
(*) Unilateral Extension Given by State

REMEDIAL NEEDS
(1) Sample &/or Report
(2) Disinfection
(3) Secondary Treatment or Equivalent
(4) Phosphorus or Nutrient Removal
(5) New or Improved Trt.
(6) Plant Expansion
(7) Reduction, Removal or Neutralization of: Acid, (Cl) Chloride, (Cu) Copper, (CN) Cyanide, (Fe) Iron, (M) Metals, (N) Nitrogen, Oil, (BOD) Oxygen Demand, (Ph) Phenol, (S) Solids, (TO) Threshold Odor,
(8) Connect to Municipal System
(9) Separation or Control of Combined Sewers
(10) Storm Sewer Treatment
(11) Exclude Clear Water
(12) Sewers
(13) Adequate Treatment
(14) Improve Operation
(15) Evaluate Present Facilities
(16) Reduction of All Critical Constituents
(17) Advanced Waste Treatment

(Compl.) Completed
(HT) Holding Tank
(ST) Septic Tank
(DF) Drain Field
(P) Persons

GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

DATE OF [illegible] Apr 1970

PREPARED BY

DESIGNATED SOURCE & LOCATION	RECEIVING WATERS	REMEDIAL NEEDS	Present Treatment	REQUIRED CONSTRUCTION SCHEDULE	STATUS OF COMPLIANCE CONSTRUCTION	Pop. and/or 1,000 GPD	COMMENTS AND/OR REASON FOR DELAY
MICHIGAN, Cont'd.							
U.S. Air Force, Cont'd.							
K.I.Sawyer Air Force Base Republic (Marquette Co.)							
Sanitary Wastes	Silver Lead Creek, tributary to Lk.Superior	4	Sec. Cl_2	PP	■	668.0	The original sewage treatment plant was hydraulically overloaded, and on occasions, the effluent did not meet water quality levels set for Silver Lead Creek, which waters the State designated as a trout stream. The Air Force in 1965 developed preliminary plans for remedial measures to meet these requirements. Due to more restrictive effluent standards imposed by the State (80% phosphate removal and 5-day BOD, max. 65 lbs./day) for discharges to trout streams, and because of budget limitations, the Air Force was required to make revisions to their design to provide the necessary treatment facilities. Accordingly, a contract was completed in Nov. 1969 for limited modification and improvements to existing primary and secondary treatment units (sludge handling and digestion improvements, weir replacement, new laboratory, oil skimmer, chlorine building, chlorine contact, new filter media) Cost $233,000. Funds for tertiary treatment facilities will be requested by June 30, 1970. USAF Regional Environmental Health Laboratory will conduct an investigation, and a pilot plant study to obtain design criteria for the new facility and completion date is expected by January 1, 1971. Tertiary treatment facilities will be completed or under construction by Dec. 31, 1972.
Industrial wastes			Holding & settling tanks with oil skimming devices & lagoon			0.11	The Air Force has requested funds for connecting the industrial waste discharge to the Base sanitary sewer system. This work cannot be accomplished, however, until the implementation of the above plans. Est. cost $59,000. This work will be completed or underway by Dec. 31, 1972.

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GREAT LAKES REGION

STATUS OF COMPLIANCE WITH ENFORCEMENT CONFERENCE REQUIREMENTS

DATE OF INFORMATION Apr.1970

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MICHIGAN, Cont'd.							
U.S. Dept. of the Interior Bur. of Sport Fisheries & Wildlife							
Pendills Creek National Fish Hatchery, Brimley (Chippewa Co.)	Pendills Creek to Lk.Superior	None	None	-	-	5,750.0	Fish hatchery effluent from fish rearing tanks.
Hiawatha Forest Fish Hatchery, Raco (Chippewa Co.)	Sullivans Creek to Lk.Superior	None	None	-	-	4,220.0	Fish hatchery effluent from fish rearing tanks.

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MINNESOTA							
U.S. Coast Guard							
Duluth Entrance Harbor Light Station Duluth (St.Louis Co.)	Lk.Superior	Sec. Cl_2	None	FI	=	4 P	Station is expected to be unmanned and automated by 1971
U.S. Dept. of Agriculture Forest Service - Superior National Forest							
Tofte Administrative Site (Cook Co.)	G	None	Sec. Cl_2	Compl.	=	10 P (75 P in future)	Construction of extended aeration plant, sub-surface sand filtration plus chlorination completed in 1969 (winter).
White Face Reservoir Camp Picnic Ground (St.Louis Co.)	G	3, 2	None	FI	=	445 P (10,000 GPD) (future)	FY 1971 funds will be requested for the construction of a sewer system, aerated lagoon, and spray irrigation system. Construction completion date summer 1972.
Eveleth Nursery Administration and Nursery Eveleth (St.Louis Co.)	G	None	Sec. Cl_2	Compl.	=	0.8	Package extended aeration plant and tile drain field constructed in 1964.
U.S. Air Force							
Finland Air Force Station Finland (Lake Co.)	Surface drainage to tributary of Baptism River thence Lk.Superior	None	Sec. Cl_2	Compl.		35.0	Contact stabilization plant (40,000 GPD) plus chlorination installed and placed in operation June 1969.

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MINNESOTA, Cont'd.							
U.S. Air Force, Cont'd.							
Duluth Air Force Missile Site, Duluth (St.Louis Co.)	Roadside Ditch	2	Sec.	FI	=	150 P 10.0	Sanitary wastes are treated in an extended aeration package treatment plant, the effluent from which is discharged without chlorination to a ditch that terminates two miles from the nearest body of water. FY 71 funds will be requested to provide chlorination facilities or make connection to a proposed municipal sewer system. Station has been informed of May 1970 deadline for providing chlorination and has been advised to take immediate action to install temporary facilities until final decision is made and project completed.
Minnesota National Guard Duluth (St.Louis Co.)	Miller-s Creek	None	None	Compl.		12.0	In October 1969, connections were made to the Duluth Municipal sewer system for sanitary waste disposal.
U.S.Dept. of Justice Immigration and Naturalization Service							
Border Patrol Station Grand Marais (Cook Co.)	Ground and Pigeon River	None	Sec. Cl_2	Compl.		2.0	During winter of 1969, completed the installation of new lift station, septic tanks and sand-gravel filter, the effluent from which, if any, is chlorinated and discharged to Pigeon River.
U.S. Army (Corps of Engineers)							
U.S.Vessel Yard Duluth (St.Louis Co.)	G	None	None	Compl.		0.20	In November 1969 connections were made to the Duluth municipal sewer system for sanitary waste disposal.

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WISCONSIN							
U.S. Coast Guard							
Bayfield Station Bayfield (Bayfield Co.)	None	None	Incinerator type toilet	Compl.		11 P	Station is manned by one person on an intermittent basis, and is equipped with an incinerator type toilet. An office trailer with sanitary tie to the existing city sewer is to be installed in the near future.
Superior Entry South Breakwater Light Station Superior (Douglas Co.)	Allouez Bay	None	ST, DF	Compl.		11 P	Station has been unmanned.
U.S. Dept. of Agriculture Forest Service Chequamegon National Forest							
Two Lakes Campground (Bayfield Co.)	G	3, 2	None	PP	■	13.0	Preliminary plans for the construction of a waterborne system with aerated lagoon, irrigation and disinfection have been completed. FY 71 funds will be requested for this project, and completion is expected by Dec. 1972.
VESSELS MINNESOTA							
U.S. Coast Guard							
USCG WOODRUSH	Lk.Superior area of operation	3, 2	None	FI	■	47 P	Development work is in process for a small package secondary sewage treatment plant plus chlorination that could be utilized on board. It appears that this effort will be successful, and that these facilities will be installed by Dec. 31, 1972. Also, shore waste unloading facilities at Duluth Harbor with connections to the municipal sewer system will be provided.

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MINNESOTA, Cont'd.							
Vessels, Cont'd.							
U.S.Army (Corps of Engineers)							
Derrick Boat DK 20	Lk.Superior	3, 2	Macerator Chlorinator plus detention tank	-	-	5	Macerator/chlorinator and detention tank for chlorine contact installed; overboard discharge. Evaluation is in progress of a recirculating-evaporating-holding type toilet. It is presently anticipated that this type of device will be approved and installed by or before December 31, 1972.
Derrick Boat - COLEMAN	Lk.Superior	3, 2	"	-	-	11	" "
Dredge - GAILLARD	Lk.Superior	3, 2	"	-	-	27	" "
Tow Boat - MARQUETTE	Lk.Superior	3, 2	"	-	-	8	" "
Tow Boat - SUPERIOR	Lk.Superior	3, 2	"	-	-	9	" "
Tow Boat - DULUTH	Lk.Superior	3, 2	"	-	-	3	" "

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MICHIGAN Vessels, Cont'd. National Park Service							
M.V. RANGER III (165')	Lk.Superior	None	HT	Compl.	•	138 P	Discharges into Houghton-Hancock municipal sanitary sewer system. This is the only passenger-carrying boat providing service to Isle Royale.
Tug J.E. COLOMBE (45')	Lk.Superior	None	HT	Compl.	•	2 P	Discharges to septic tank and drain field at Mott Island Headquarters when necessary
M.V. CONRAD L (26')	Lk.Superior	HT	None	-	-	2 P	Portable holding tanks have been recommended for emergency use, since vessel is only used for inter-island travel by NPS employees.
M.V. DEMRAY (26')	Lk.Superior	HT	None	-	-	2 P	" " "
M.V. LOUIS J. (26')	Lk.Superior	HT	None	-	-	2 P	" " "
M.V.C.M. GOTHE (26')	Lk.Superior	HT	None	-	-	2 P	" " "

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MR. STEIN: Thank you, Mr. Gamet.

Are there any comments or questions?

Yes, Mr. Purdy.

MR. PURDY: I have one, Mr. Stein.

First of all, I would like to state that in the matter of the operating reports that we are pleased to see this change and we look forward to the improvements that we believe this will bring about. The Calumet Air Force Base states it has had an operating problem for sometime and hopefully this will help rectify that problem.

Witn respect to the number 2 item, though, the K. I. Sawyer Air Force Base, it is my understanding from our people that we have in the upper peninsula that the modifications that took place and that became operable in November 1969 were those that would primarily make the operations of this plant easier and that they did not add additional capacity to the plant. Plans have been prepared for an additional trickling filter. This trickling filter was not a part of this construction. The plant has been overloaded. It has caused conditions in the receiving stream in violation of the State standards.

We do not believe that the changes made last year will correct this condition. And it is our understanding that a study will be initiated this coming summer to review again what is necessary. But in our review of this situation, expansion of the K. I. Sawyer Air Force Base facilities still is necessary and then beyond that the matter of phosphorus removal.

MR. STEIN: Why do they need a study, Mr. Purdy?

MR. PURDY: I am not sure why the study is needed when earlier studies showed that there was a need for an additional trickling filter. It was not constructed. It would seem as though this additional trickling filter is still needed.

MR. GAMET: It is my understanding that this study will be made to determine design criteria for nutrient removal, primarily.

MR. PURDY: Oh. What I am stating, that beyond nutrient removal there is the need for additional facilities to provide a higher degree of carbonaceous oxygen demand removal and that this has existed for some time.

MR. STEIN: Do you agree with that, Mr. Gamet?

MR. GAMET: Yes, I believe that is correct.

MR. STEIN: And they don't need a study in order to determine that--that they have to do it?

MR. GAMET: No, sir.

MR. STEIN: Are they committed to doing that?

MR. GAMET: No, so far as I know, but they will certainly be put on notice immediately.

MR. STEIN: All right. Because again, I don't see any virtue in going through these studies with Federal facilities when we don't permit a city or an industry to have that privilege. If they need the removal, then they need it. And I don't think this stuff has to be studied if this isn't meeting the water quality standards of Michigan.

Is there any disagreement with that?

MR. GAMET: No, sir.

MR. STEIN: All right.

Well, I wonder again, Mr. Gamet, if you can put the installation on notice and have a report for us at the next session on this. There may be noncompliance, but I think the issues are clear as to what they have to do.

MR. GAMET: We will be in contact with them, and we will have a report at the next session of the conference.

MR. STEIN: Right.

Any other comments or questions?

MR. FRANGOS: Mr. Chairman.

MR. STEIN: Yes.

MR. FRANGOS: I notice in the report there were several references to May 1972, and this is just a point of clarification. Is this a self-imposed deadline by the Federal Government?

MR. STEIN: Mr. Gamet.

MR. GAMET: Did I understand you to say December 1972?

MR. FRANGOS: December, I am sorry, yes.

MR. GAMET: That is a requirement of Executive Order 11507, which states that all Federal facilities will have adequate treatment facilities installed or under construction by December 1972, and further that each agency will prepare a report and submit it to the Bureau of the Budget by June 30, 1970, for these projects.

MR. FRANGOS: Fine. We are pleased to see it. As you know, the Executive Order has been in existence for a number of years, and we commend the Administration for moving forward.

MR. STEIN: No, this is a new one, Mr. Frangos. I think this one is really a different kind because this last one provides the funding as well as the direction.

MR. FRANGOS: Fine. That has been everybody's problem.

MR. STEIN: Right.

MR. GAMET: I might add one more thing. The Executive Order further states that funds that are appropriated for this purpose may not be used for any other purpose.

MR. FRANGOS: That is good to know.

MR. STEIN: Are there any further comments or questions?

It not, thank you very much, Mr. Gamet.

We will stand recessed for 10 minutes. And don't go away, because Dr. Mount comes next.

(RECESS)

MR. STEIN: Let's reconvene.

Mr. Mayo.

MR. MAYO: Mr. Chairman, in response to Mr. Purdy's question about additional studies at the K. I. Sawyer Air Base, there is a point of confusion between the inquiry by Mr. Purdy and the response by Mr. Gamet. Mr. Gamet would like to clarify that.

MR. GAMET: For the purposes of the record, I would like to clarify the statement which I made regarding a study which is proposed at K. I. Sawyer Air Force Base. I stated that this study was for the purpose of determining design criteria to provide nutrient reduction. This is incorrect. The statement is that the study is required in order to determine what facilities are necessary to meet present State standards, which is not more than 64 pounds per day of BOD discharged into the receiving stream.

This is the purpose of the study.

MR. MAYO: Thank you.

Does that answer your question, Mr. Purdy?

MR. PURDY: My only point on the earlier question was that I did not want the record to indicate that the facilities that were built last year were sufficient to meet State standards other than phosphorus removal and that there is still a need for other facilities.

MR. GAMET: One other point I might make is that they are quite certain that the addition of another trickling filter will not be adequate to meet the present State standards and they want to determine what is required to meet those standards.

MR. STEIN: Thank you.

MR. MAYO: There is one other Federal agency wishing to make a short statement.

Is Mr. Earl Terpstra of the Soil Conservation Service here?

EARL TERPSTRA, PLANNING STAFF LEADER
SOIL CONSERVATION SERVICE, U. S.
DEPARTMENT OF AGRICULTURE, MICHIGAN

MR. TERPSTRA: I am Earl Terpstra, Planning Staff Leader, Soil Conservation Service, USDA, Michigan.

E. Terpstra

I am presenting a statement for the United States Department of Agriculture by Arthur H. Cratty, Commissioner, Agriculture, Great Lakes Basin Commission.

At the first session of the Lake Superior pollution conference, a statement was presented for the U. S. Department of Agriculture. The statement outlined the programs and assistance of USDA. This statement will deal more specifically with the problems and needs of the basin with regard to pollutants.

We have identified the amount of sediment contributed to Lake Superior by hydrologic units. The total amount of sediment delivered to Lake Superior in the United States is approximately 184,000 tons per year. Sheet erosion accounts for 64 percent of the sediment, streambank erosion accounts for 16 percent, and 20 percent comes from urban construction and roadside erosion. For the record, Mr. Chairman, Attachment 1 is a summary of the estimated annual sediment delivered to Lake Superior by hydrologic unit. In addition, Attachment 2 is a map showing the location of sediment production along major streams. Let me point out the map is preliminary, subject to revision, but does pinpoint the location and relative intensity of sediment production.

In the United States portion of Lake Superior, there are approximately 700,000 acres of cropland, to date 315,000 acres have been adequately treated. The primary needs to reduce erosion and sedimentation are terraces and strip cropping on 25,000 acres and cover crops and crop residue use on 54,000 acres. Improved rotation to include legumes and grasses are needed on 61,000 acres.

Of the 165,000 acres of pastureland in the basin, approximately 31,000 acres need improvement and 26,000 acres need to be better managed.

Much is being accomplished with the ongoing programs. For example, 141,600 acres have been planted to trees; 206,000 acres have an adequate crop rotation; 2,670 acres of grassed waterways have been applied; 13 miles of terraces have been constructed; 2,330 acres of strip cropping installed; and 3,400 acres of contouring have been applied. All of the above practices contribute to the reduction of erosion and sedimentation.

Another source of pollutant has come from

E. Terpstra

mining operations. We have been assisting some mining companies with technical assistance. For example, we have provided technical assistance to the White Pine Copper Mine located in Michigan. We have recommended various plant materials for slopes of dykes and restoration of the dyked areas where they are filled. We have also assisted the Calumet and Hecla mine in Michigan with stabilizing mined wastes of finely crushed rock.

Another source of sediment comes from logging operations. We are presently exploring methods to work with loggers to control this source of sediment.

From this information, it is evident that an accelerated land treatment and sediment control program is urgently needed. The realization of such a program will be dependent upon a cooperative endeavor of individual landowners, local and State government, and the Federal Government. It must be remembered that carrying out these practices is voluntary on the part of the landowner, and we in USDA do not have policing powers, or powers to construct, operate, and maintain practices on private lands.

Item 18 of the conclusions of the first conference summary charged the Wisconsin conferees to distribute information to the other conferees concerning the action plan developed by the Red Clay Inter-Agency Committee and report on the activities of the Red Clay Inter-Agency Committee at the next conference session. Because of the above charge, I will not report on the Red Clay area. If I can be of assistance to you or the conferees regarding the Red Clay area, please let me know.

Mr. Chairman, this concludes my report.

MR. STEIN: Thank you, Mr. Terpstra.

(Items 1 and 2 follow.)

Attachment 1

Lake Superior Basin (U. S. Portion)

Estimated Average Annual Sediment Production by Hydrologic Units

Unit	Erosion Source - Tons Per Year				
	Sheet	Streambank	Urban	Roadside	Total
Superior Slope Complex	24,100	5,600	15,400		59,200
St. Louis River	6,400	3,000			
Nemadji River	4,200	500			
Apostle Islands Complex	25,700	4,200			29,900
Bad River	8,500	1,000			9,500
Montreal River	2,400	400			2,800
Porcupine Mountain Complex	11,100	2,500			13,600
Ontonagon River	2,800	1,300			4,100
Keweenaw Peninsula Complex	14,200	3,300			17,500
Sturgeon River	2,200	900			3,100
Huron Mountain Complex	5,900	2,300			8,200
Grand Marais Complex	7,300	2,900			10,200
Tahquamenon River	1,100	900			2,000
Sault Complex	1,700	600			2,300
-				21,600	21,600
Basin Total	117,600	29,400	15,400	21,600	184,000
Percent of Total	64[1]	16[2]	8[3]	12[4]	100

1/ Based on an average annual rate computed from conservation needs data by soil resource areas. Delivery ratios applied based upon drainage area size averages.

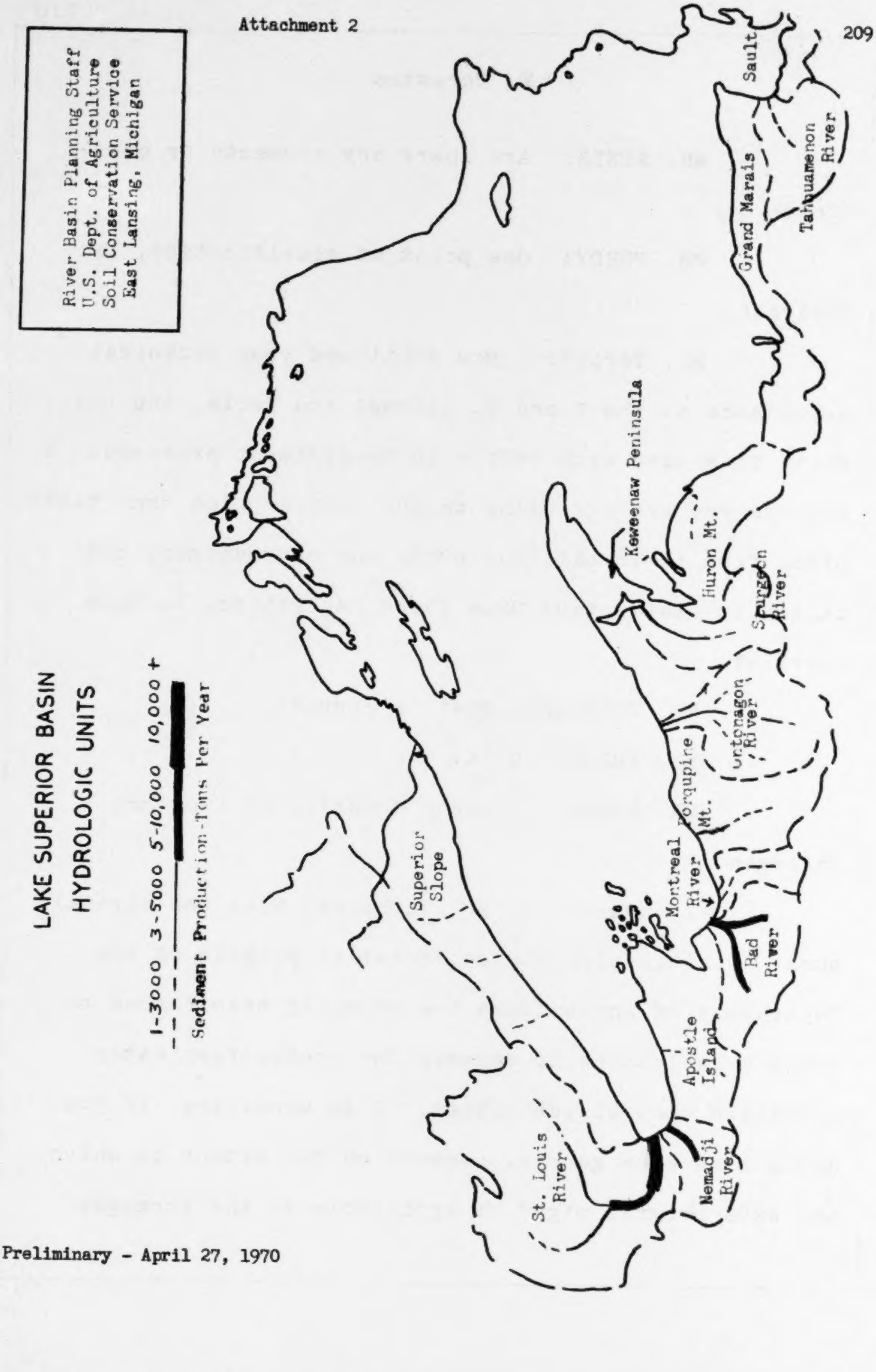
2/ Based upon average erosion rate of 27 tons per square mile found in recent streambank erosion study. Delivery ratios applied.

3/ Duluth-Superior metropolitan area. Based upon present average annual erosion from urban construction of 76,000 tons (from urban erosion evaluations in Great Lakes Basin Framework Study). Delivery ratio of 25 percent assumed.

4/ Based upon recent roadside erosion study in Wisconsin. Rate of 20 tons erosion per square mile. Delivery ratios applied.

Preliminary
April 27, 1970

Attachment 2



1-3000
3-5000
5-10,000
10,000 +
Sediment Production-Tons Per Year
Sault
Tahquamenon River
Grand Marais
Keweenaw Peninsula
Huron Mt.
Sturgeon River
Ontonagon River
Porcupine Mt.
Superior Slope
Montreal River
Bad River
Apostle Island
St. Louis River
Nemadji River

LAKE SUPERIOR BASIN
HYDROLOGIC UNITS

River Basin Planning Staff
U.S. Dept. of Agriculture
Soil Conservation Service
East Lansing, Michigan

Preliminary - April 27, 1970

MR. STEIN: Are there any comments or questions?

MR. PURDY: One point of clarification, Mr. Chairman.

Mr. Terpstra, you mentioned your technical assistance to the C and H, Calumet and Hecla, and the White Pine mine with reference to sediment problems. I believe you are referring to the soil erosion that takes place from their tailings ponds and not sediment contained in wastewaters from these facilities, is this correct?

MR. TERPSTRA: That is correct.

MR. PURDY: O. K.

MR. MAYO: I have a question or two, Mr. Chairman.

I understand, Mr. Terpstra, that the agricultural stabilization and conservation program of the Department of Agriculture has recently been funded to include assistance to farmers for on-the-farm water pollution control activities. I am wondering if you could make some general comment on the extent to which the ASCS program might be applicable to the acreages that you indicate still need treatment. Is the ASCS program likely to offer much of an opportunity for corrective actions on the acreages that you have identified as needing additional treatment?

MR. TERPSTRA: I really cannot speak to that point. The impact, as I understand it today, is pretty much for treating farm wastes, lagoon systems, and this type; whereas, the sediment erosion or most of the sediment erosion we are talking about here comes from the cropped acreages itself as well as the urban buildup areas, urban construction, this type of activity.

So I am afraid I can't answer your question.

MR. MAYO: As I understand it, each ASCS committee develops a handbook of accepted practices that the Federal Government will share the cost in, in terms of on-the-farm improvements for water pollution control. It seems to me that at the moment most of the water pollution control practices have been directed toward the control of livestock wastes, that sort of thing.

MR. TERPSTRA: This is correct.

MR. MAYO: We aren't aware yet that the committee is considering participating in a wider range of practices that might offer an opportunity for substantial relief in sediment control, and I would certainly recommend that the ASCS committees begin to look at the use of these funds for on-the-farm water management activities that extend beyond the livestock waste controls into the area of sediment control.

MR. STEIN: Any other comments or questions?

I would like to commend you, Mr. Terpstra. And I would like to say, in my experience, this is the first time we have been able to get specifics from the Department of Agriculture as to the kind of waste coming in, rather than glittering generalities.

Let me ask you something again. I don't want to kill the goose that lays the golden egg, but we got the sediment production reports by hydrologic units. What we have been really striving to get is the amount of pesticides, the poisons and the nutrients that are going into the lake. Do you think by the end of July you can give us a breakdown on that like you have given us on this?

MR. TERPSTRA: That, Mr. Chairman, is highly doubtful.

MR. STEIN: Pardon? I didn't hear that.

MR. TERPSTRA: That is highly doubtful that this could be done by that time.

MR. STEIN: When can we get that? You see, we are interested in keeping sediment out of the lake, but we are also interested in keeping out nitrogen, phosphates and fertilizers or any of the runoff from the pesticides or insecticides or herbicides which are used on the land. We have never been able to get a report on precisely what is used. We surely haven't got what is runoff into the lake, particularly in Lake Superior. Until we begin getting an inventory on that and perhaps controlling it, I am not sure we are going to control water quality in the lake.

MR. TERPSTRA: One of the problems, Mr. Chairman, that we in the Soil Conservation Service, while we have some expertise in the sediment field, do not have the necessary expertise, I feel, in this pesticide range, so I am afraid that we are going to have to--

MR. STEIN: Don't they have that in your

Department?

MR. TERPSTRA: The Agricultural Research Service, I would presume, probably have and are continuing studies on this, but I cannot speak for them today.

MR. STEIN: All right.

Is there any other--

MR. FRANGOS: Could we have copies of that report, Mr. Chairman?

MR. STEIN: By the way, I think this is an important report. I don't know how many copies we have, but we will have these duplicated and transmitted to the conferees. (See pages 208 and 209.)

By the way, I do think this is a breakthrough. This is the first time we have ever gotten this, and really I want to commend you and the Soil Conservation Service for this. This is great.

MR. TERPSTRA: Thank you, Mr. Chairman.

One other item I might want to point out in regard to pesticides, the Great Lakes Basin Commission, in connection with one of their limnological systems analysis, I believe are going to do some work on this aspect. Mr.

Gene Jarecki, a member of the staff, is here today and perhaps he could enlighten some on this aspect.

MR. STEIN: You put him on the spot, I didn't. I don't know if he wants to. (Laughter.) Does he want to come up or not?

Yes, come on up.

GENE JARECKI
GREAT LAKES BASIN COMMISSION
ANN ARBOR, MICHIGAN

MR. JARECKI: I am Gene Jarecki with the Great Lakes Basin Commission staff. Just a few words in regard to what Mr. Earl Terpstra has mentioned.

One of the needs which is recognized in the Great Lakes Basin Commission is the unfortunate present state of the art in terms of available procedures for predicting effects on the lakes of various management measures and alternatives. Because of the complexity of the problem and the lack of any single organization charged with the managing of the Great Lakes Basin environment, there is a serious lack of adequate data for quantitative description of the lakes and a

G. Jarecki

deficiency in the understanding of the physical, chemical, and biological processes which operate within the lake system. Recognizing this, the Great Lakes Basin Commission is in the process of evaluating the feasibility of mathematical modeling of the lakes in order to provide a procedure for quantitatively predicting the effects on the lakes themselves of the various structural and nonstructural management alternatives on the lakes and within the contributing drainage areas of the Great Lakes Basin. The study schedule to be completed in about a year will serve to integrate and coordinate the individual efforts of the member agencies within the basin, and this includes the Lake Superior area, and will not be a duplication of the existing or future efforts.

This is where we are trying to point out the effects of the man-made activities on the land, what they will do on the lakes. At the present time we just don't have adequate tools to do this, and hopefully by integrating all of the chemical, biological and physical aspects on the lakes we can produce a tool that will be effective in evaluating the effects on the lakes.

MR. STEIN: Are there any comments or questions?

I hope the results will be a little more specific than the prospectus. (Laughter.)

MR. JARECKI: I may point out that our first study is getting into a feasibility or practicability study. In other words, a mathematical modeling of the lakes is a big effort and we are trying to evaluate first what data is available on the lakes. And incidentally, we are working on a cooperative informal basis with some of the Canadian people also on this. And until we evaluate just what can be done in a major mathematical modeling of the lakes, it will take some time.

MR. STEIN: Well, again we are asking very specific questions--what kind of pesticides, insecticides, herbicides, what kind of poisons are going into the lake; what kind of nutrients are going into the lake? You know, after hearing our own people, I hesitate any more to criticize those Russians for the kind of political double talk they put out. Any time I hear that we are going to have a real thorough evaluation, go into mathematical models, look at the chemical, physical and biological features, and it is going to take some time, I know where we are. This is like talking about people and saying we have to think about men, women and children. I don't know who else you think about. (Laughter.)

The point is, we have not been able to get any specifics on what agriculture is putting in. Our Assistant Secretary, Carl Klein, has said that we are on our way with industry; we are on our way with municipalities; but possibly one-third of the problem is agriculture. We have not got this. For the first time we got a breakthrough on the sedimentation runoff. Again I cherish this (laughter). But I think until we are going to get the material from the agricultural people on what is running off the land from the application of fertilizers and all the other ingredients you put on to protect the crops, we are not going to be able to deal with this pollution problem, even if we clean up every last bit of industrial and municipal wastes in Lake Superior, including the feedlots.

With all the acres that they are talking about here, we still haven't got that. All we are getting is the notion that we are thinking of a mathematical model, which will take some time. Can we ever get a notion on how much fertilizer and pesticides, insecticides and herbicides are sold in the counties that drain into Lake Superior and what the amounts are and the constituencies of these are? We have been trying to get that for years.

MR. JARECKI: I agree with you, Mr. Chairman, 100 percent. Incidentally, the results of the sediment study that were just presented are part of the framework study that the Great Lakes Basin Commission is undergoing at the present time. Hopefully we will try to get--and when I say "we" I mean all the agencies and the States that are involved in this study--will prepare and get all the data that is available. And, unfortunately, there are basic data gaps in this, as was pointed out previously. And whatever we can utilize we will evaluate.

MR. STEIN: All right. Thank you.

Are there any comments or questions?

If not, thank you very much.

Mr. Mayo.

MR. MAYO: The next report will be presented by Dr. Donald Mount of the National Water Quality Laboratory on effects of taconite on Lake Superior.

DR. DONALD I. MOUNT, DIRECTOR
NATIONAL WATER QUALITY LABORATORY
FEDERAL WATER QUALITY ADMINISTRATION
DULUTH, MINNESOTA

DR. MOUNT: My name is Donald Mount. I am Director of the National Water Quality Laboratory, Federal Water Quality Administration, United States Department of the Interior, in Duluth, Minnesota.

Mr. Chairman, I am not sure whether I can go off the record or not. What I have to say first does not really need to be on it.

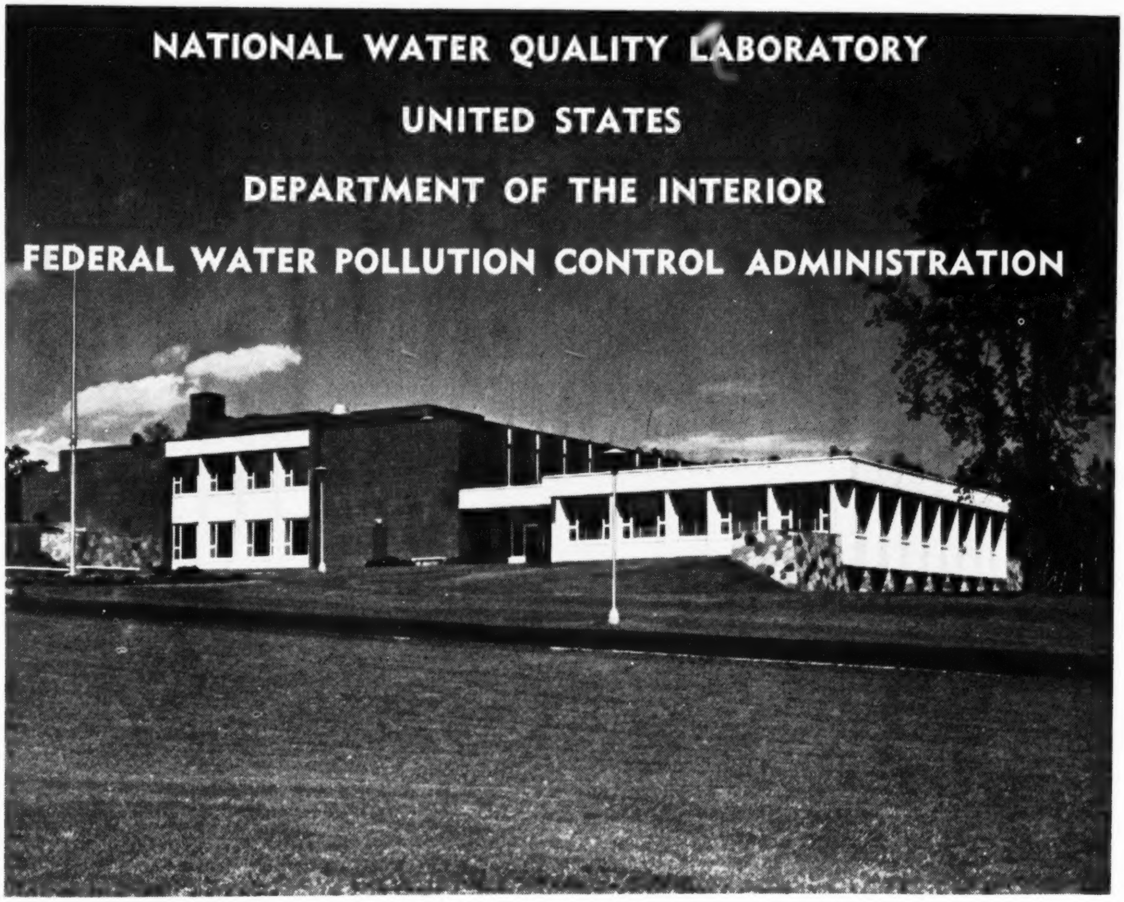
(Off the record.)

DR. MOUNT: I would like to take this opportunity in a more serious vein to thank my staff, some of which are sitting at the back tables, for the long hours that they have put in. And while I am reluctant to say, Mr. Chairman, that I am presenting additional studies, that is what I am doing, and I will try to be specific and not present models.

I would like at this time to submit to the record for inclusion in it, if possible, a copy of the six technical reports which were mailed to the conferees and of which you have copies now.

MR. STEIN: Without objection, this will be entered into the record as if read.

(Which said reports are as follows:)



NATIONAL WATER QUALITY LABORATORY
UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

EFFECTS OF TACONITE ON LAKE SUPERIOR

April, 1970

EFFECTS OF TACONITE ON LAKE SUPERIOR

April, 1970

TABLE OF CONTENTS

		Page
I.	Physical Characteristics of Green Water along the North Shore of Lake Superior	4
II.	Distribution of Taconite Tailings in the Sediments of the Western Basin of Lake Superior	29
III.	Effect of Taconite on Bacterial Growth	52
IV.	Taconite Bioassays	66
V.	Effect of Taconite Tailings on Algal Growth	73
VI.	The Dissolution of Taconite Tailings in Lake Superior	87

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I. Physical Characteristics of Green Water Along the North Shore of Lake Superior

Conclusions:

1. A major cause of "green water" along the north shore is tailings suspended in the water.
2. Not all green water masses occurring in Lake Superior are due to tailings.
3. Water clarity in green water, caused by tailings, is 4 to 10 times less than clarity in clear water.
4. The color is due to reflected light from suspended particles.

II. Distribution of Taconite Tailings in the Sediments of the Western Basin of Lake Superior

Conclusions:

1. Taconite tailings from the Reserve Mining Company at Silver Bay, Minnesota are deposited discontinuously on the surface of the lake bottom over an area of at least 1,000 square miles in the western tip of Lake Superior.
2. The tailings are mixed in the top 5-10 cm of sediment.
3. The percentage of cummingtonite in tributary stream sediments accurately indicates the cummingtonite content found in the subsurface bottom sediments.
4. Tailings deposits are found in both Minnesota and Wisconsin waters. Although the sediments in Wisconsin waters contain very low percentages of taconite tailings, the tailings deposits are distinguishable quantitatively from stream sediments.

III. Effect of Taconite on Bacterial Growth

Conclusions:

1. Tailings are biologically active at concentrations of approximately 1 mg/l -- a concentration expected to occur over a significant area of the Lake.
2. The reduced die away or enhanced growth is displayed by indicators of fecal contamination, as well as pathogenic bacterium.

IV. Taconite Bioassays

Conclusion:

Direct toxic effects of tailings on the lake organisms were found at concentrations that would be expected to occur only in local areas of the Lake.

V. Effect of Taconite Tailings on Algal Growth

Conclusions:

1. Algal growth rate was higher in 10% (16 mg/l particles <2µ) taconite tailings suspensions.

2. Increased growth rates are related to increases in soluble silica from the tailings and subsequent utilization by diatoms.

VI. The Dissolution of Taconite Tailings in Lake Superior

Conclusions:

1. In addition to the increase in soluble salts as the ore is processed, taconite tailings show continued solution after leaving the plant.

2. The rates of dissolution increase with decreasing concentrations of particles/unit volume of water and with increasing temperature.

3. After 332 days, increases in soluble components from tailings in Lake Superior water under simulated lake conditions were:

Component	Increase in mg/kg total tailings
SiO_2	331
Na	37
K	7
Ca	282
Mg	11
SS	61
TDS	1110

PHYSICAL CHARACTERISTICS
OF GREEN WATER
ALONG THE MINNESOTA SHORE OF LAKE SUPERIOR

Robert Andrew and Gary Glass

INTRODUCTION.

As a result of public concern regarding the phenomenon of "green water" along the Minnesota shore of Lake Superior, scuba divers on the staff of the National Water Quality Laboratory conducted a field investigation to observe the physical characteristics of green water and to obtain samples of accurately positioned sampling devices so that the appearance of the water at the point of sampling would be known.

The sampling was performed between the dates of September 10 and October 11, 1968, during a period in which green water was usually present. Throughout this period, green water was not observable northeast of the Reserve Mining Company effluent regardless of the prevailing wind directions. On each visit areas of green water were present, beginning at the Reserve Mining Company discharge and extending southwest, often as a continuous mass of green water and observed as far as Gooseberry River. Discontinuous green water masses were observed from the boat and from an automobile as far south as Crow River.

During sampling periods in front of the Reserve Mining Company delta, billowy gray clouds of waste were visable both from the surface and by the divers under water and extended off shore as far as 300 feet and to a depth of 35 feet. These clouds were not seen, however, beyond

Reserve's southwest breakwall.

Field Collecting Methods.

Water samples from green and clear water masses were collected by divers by positioning hoses, connected to a pump, at the proper location beneath the surface and pumping water from the selected point into polyethylene sample bottles. The pump was operated a minimum of ten minutes before samples were collected. Water clarity measurements were made with a standard Secchi disc 8" in diameter with black and white alternating quadrants, and attached to a line marked in fathoms. Surface mileages were computed from the rate of speed and time. Bottom depths at all stations were determined by a Raytheon Fathometer, Holiday Mark II Model DE-716.

Field Observations.

Divers reported that green water appeared to form as gray clouds of tailings diffused into the clear lake water. The water appeared green to the divers whether they observed it by looking upward, downward, or horizontally. Measurement of light penetration by use of a Secchi disc indicated that water clarity in clear water was three to four times greater than water clarity in green water. On one occasion the width of the green water band was followed by visual observation and Secchi disc readings and was found to extend two miles offshore. Divers reported that green water was consistently much more turbid than clear water; underwater visibility was commonly five feet in green water stations and 35 to 40 feet in clear water stations. At night the green water appeared gray in color and the divers reported that particles appeared in a flashlight beam in a way similar to dust in a sunbeam passing through dusty air.

Methods for Laboratory Investigations of Water Samples.

All water samples were filtered directly, without pre-treatment, to remove the suspended solids. A total volume of lake or stream water estimated to contain approximately 1 to 15 mg of suspended matter was filtered through a pre-weighed .45 micron membrane filter. The filters were dried overnight at 70° C and re-weighed to determine the concentration of solids. For mineralogical investigations, the dried filters were mounted on glass slides and subjected to X ray diffraction analysis. Samples were scanned at 2° (2-theta) per minute using a Picker horizontal arc diffractometer, copper X ray tube, and nickel filter.

Diffraction intensities were measured using a NaI scintillation detector, single channel pulse height discriminator, and a ratemeter recorder. All samples were run using a ratemeter range of 0-1,000 cpm and a 3-second time constant. For the resolution and accurate determination of spacings, some samples were scanned at 1/2° per minute. Size fraction separations were made by sedimentation (2) and the percentage of the fractions obtained were calculated (dry weight basis).

A Cary Model-14 ratio recording spectrophotometer equipped with a High Intensity Visible Source Accessory No. 1471200 was used to record the optical density and wavelength measurements. Reflectance measurements were made on solids using the Cell Space Total Diffuse Reflectance Accessory, Model No. 1411750. Liquid samples were viewed through 10 cm. cells with quartz windows. The reflectance spectra of solid samples were recorded directly from the 0.45μ Millipore filter membranes upon which they had been collected. The wavelength, λ, calibration of the spectrophotometer was effected by using a NBS holmium oxide glass, No. H-122. The optical density of absorbance calibration was made using neutral density filters of known value.

Results of Laboratory Analyses.

Results of the mineralogical analysis of the suspended solids fraction ($> 0.45\mu$) of Reserve Mining Company effluent and the north shore streams are shown in Table 1. Examples of X ray diffraction patterns obtained, are shown in Figures 1 and 2.

The X ray diffraction analysis of the tailings indicates that cummingtonite and quartz are the major constituents of all fractions examined, with minor amounts of chlorite and mica also present. The magnetite known to be present is apparently not sufficiently crystalline to be shown by X ray diffraction. Cummingtonite is proportionately higher than quartz in the less than $2\,\mu$ fraction; quartz is the dominant mineral in the coarse fractions. Some separation due to sedimentation of these fractions can be observed in the tailings at the delta as evidenced by the two water samples that were collected by the divers at 50 and 100 feet. The sample at 100 ft. contained large silt and sand particles (mostly quartz) that were easily visible following filtration and were not present in the samples collected at 50 ft.

In contrast, the samples from the north shore streams, that were collected by resuspending bottom sediment in stream water, are marked by an entirely different suite of minerals. The normal group of soil clay minerals prevails, including kaolinite, mica, vermiculite, chlorite, the feldspars, and quartz. In two samples (19 and 21) minor traces of an amphibole were found and tentatively identified as cummingtonite. An insufficient amount was present for positive identification.

The distinguishing characteristics of the tailings are: 1) large quantities of cummingtonite, especially in the 2 -.45 μ fraction and, 2) absence of feldspars and kaolinite.

In cooperation with personnel from Reserve Mining Company, additional water samples were collected by the divers along the Wisconsin shore of Lake Superior in early November. On the basis of aerial observations, an area of "yellow-green" water was identified, approximately 2 1/2 miles northeast of Port Wing, Wisconsin, that extended roughly one mile into the Lake. This area of highly turbid water was produced by heavy local runoff following rainfall. Observations by the divers indicated that near the edges of the turbid area the water color was a dull brown to greenish-yellow and that, because of the turbidity, light penetration was less than 6 feet.

Analysis of one water sample collected by the divers contained a suspended solids content ($> 0.45\ \mu$) of 2.7 mg/l. X ray diffraction analysis of these solids indicated that montmorillonite, mica, chlorite, and quartz were the dominant minerals present. Traces of feldspar and an unidentified amphibole, possibly cummingtonite, were present. The X ray diffraction pattern recorded for the solids from this sample was similar to those obtained from the finer fractions of bottom sediments collected in this area of the Lake.

As early as 1949 the conclusion was reached by Trathewey (3) that "identification of minerals in the sediment will not likely enable an investigator to determine the source, since many minerals are common to both the shore rocks and the iron ore deposits." Trathewey's identification of grunerite (by microscopic examination) in a single fraction of a single bottom sample appears to be the basis for the general conclusion that "grunerite" is unreliable as an "identifier" of taconite tailings (4). This is an unwarranted generalization from such limited data and ignores completely the marked differences in mineralogy and particle size differences that do exist between "tailings" and natural sediments. Grunerite (and similar amphiboles) may occur in the stream and lake sediments, but only as a minor constituent of the silt and sand fractions.

Trace amounts were found in two of the six streams samples. (See additional data in Table 1 of Lake Sediment Report.) There was an absence of grunerite and other amphiboles in the <2 μ fractions of the stream bottom sediment samples analyzed (see Table 1). Grunerite (or most probably cummingtonite) is a major constituent of the taconite tailings in all size fractions, including those less than 2 μ (clay size). This size fraction was not considered or analyzed in earlier reports (3, 5).

The present study indicated that "grunerite" in the tailings is a physical mixture of two amphiboles, probably cummingtonite and grunerite. Based on comparisons with X ray diffraction studies of reference cummingtonite and grunerite specimens, and on published work (6) (7), cummingtonite is the major amphibole mineral present in the taconite tailings with an admixture of a small amount of grunerite. A total of 7 X ray diffraction spacings have been resolved for the major amphibole found in the tailings and the spacings agree more closely with those for reference cummingtonite rather than those for grunerite. The mixture of cummingtonite and grunerite thus found serves as a unique means of identifying the taconite tailings. The relative quantities of the two that are present in a tailings sample may be dependent on the particular source(s) in the mine, although this should be verified.

Results of the analysis of the Lake water samples are shown in Table 2. These results have been grouped on the basis of visual observation into "clear" and "green" waters. Within groups, the samples are listed in order from Northeast to Southwest.

The more obvious analytical differences shown in Table 2, are in the suspended solids and cummingtonite-grunerite content of these solids. A suspended solids content of approximately 1 mg/liter or more occurred in water having a characteristic "green water" appearance. The water samples collected in "green water" areas on October 1 and 8, 1968 (Nos. 26, 28, 31 and 32) were collected at the edges or near limits of the "green water" areas and show solids contents near, or slightly less, than the 1 mg/l limit.

The suspended solids from Reserve's discharge, as identified by their cummingtonite contents are shown in Table 2. The amount of tailings varies inversely in proportion to the distance from the effluent delta--evidence that it is the source of the suspended solids and of the "green water." As additional evidence of the source of the "green water" solids, selected samples were subjected to more detailed X ray analysis. Sample 8 (collected 3 1/4 miles southwest of the delta), sample 15 (collected midway between Split Rock and Gooseberry Rivers), and sample 32 (collected 1/2 mile out from Crow River) each showed the presence of the mixture of cummingtonite and grunerite, as well as quartz, characterizing the taconite tailings, as noted earlier.

To statistically validate the cummingtonite-grunerite mixture in the suspended solids as a unique tracer, the X ray diffraction peak heights for both the cummingtonite and quartz in the samples were subjected to statistical analysis. Regression analysis of peak height vs. the weight of suspended solids showed correlations of 0.90 for cummingtonite and 0.79 for quartz with standard errors of estimate of the mineral contents (X) of ± 0.133X and ± 0.201X respectively, for 10 mg samples. The implications of these statistical analyses are:

1. The cummingtonite and quartz contents of the suspended sediments fall within a very narrow range.

2. These suspended sediments arise from a common source which is relatively uniform in its composition of cummingtonite and quartz.

There is strong evidence that bottom sediments or stream sediments are not the source of the cummingtonite or quartz in the "green water." With equal sample weights, kaolinite and other clay minerals are below limits of detection (by the X ray techniques used) in the vicinity of the plant, because cummingtonite and quartz predominate in the suspended solids in this area. At greater distances the suspended cummingtonite-quartz solids are diluted and traces of clay minerals are found again in the suspended materials because they constitute a larger portion.

The optical absorbance spectra of "clear," "green," and "gray" water samples show a small absorbance versus distilled water over the wavelength range from 7400 Å to 3000 Å. This absorbance is characteristic of particles suspended in the liquid sample and is due to scattered light. The magnitude of this absorbance is approximately proportional to the quantity of suspended particles present. The concentration of the particles increased in the order "clear," "green," "gray" for liquid samples. The concentration of any dissolved substance which could give rise to an absorbance was not great enough to be detected using a 10 cm. cell path length.

The scattered or reflected light due to the suspended particles was studied by recording the total diffuse reflectance of the suspended solids after they were collected on a 0.45 μ Millipore filter. Typical spectra for the solids obtained by filtering the same volume of "clear water" and "green water" samples are shown in Figure 3. The number of the spectral traces correspond to sample numbers listed in Tables 1 and 2. The lower two traces are from the solids in 3 liters each of "clear water." The upper two traces are from the solids in 3 liters each of "green water." The absorbance bands at 4200, 6100, and 6700 Å have the same approximate ratio as those for chlorophyll A (8). In Figure 4 typical spectra for the same weight of solids obtained by filtering "clear" and "green" water samples of different volumes are shown.

The most striking feature is the increase in absorbance of light at 4000 Å that can give rise to a visually (to the eye) observable yellow-green color (9). Figure 5 gives a comparison of the typical spectral traces for solids obtained from "clear," "green," and "gray" water samples.

The reflectance spectra of all solid samples have the same general shape, showing an increase in absorbance at shorter wavelengths. All the "green water" solids spectra are similar in shape. The increase in absorbance at shorter wavelengths may be attributed to either an absorption band which is characteristic of the composition of the solid or to a light scattering effect due only to the size distribution of the particles or a combination of both. For effective light scattering by small particles, the particle size must be in the order of 0.05x (wavelength of the light being scattered or absorbed), (10). The theoretical absorbance due to light scattering by small particles varies with the wavelength of the scattered light. The equation (10) is: Absorbance (scattering) = (constant) x (wavelength) $^{-y}$, where y = 4. In practice this equation is obeyed to the extent that y ranges from 3 to 4 for particles whose size is less than 150 Å (11). For particles greater than ~150° Å, y is less than 3. The mathematical analysis of the average "green water" solids spectra obey the above equation, where y ranges between 2.4 to 3.7. The analysis of the "clear water" solids spectra give y in the range of 2 to 3.

The mathematical analysis of the "green water" solids reflectance spectrum using a chromaticity diagram (12) gives the dominant wavelength of the reflected light of ca. 5750 Å. Light of this wavelength is visually observed as a yellow-green color.

The "clear," "green," and "gray" water samples can be differentiated by the quantity of suspended particles present in each and by the reflectance spectra of the filtered solids. For the same volume of each type of water sample, the absorbance increases in the order "clear," "green," "gray" for the solids which have been filtered from the samples.

Since the spectra of the "green" water solids obey the scattering equation for small particles, the absorbance of light can be attributed to light scattering effects of particle size (and geometry) and not necessarily to the composition of the particle. The dominant wavelength of light reflected from these solids is ca. 5750 Å.

The scattering efficiency of particles increases as the particle size increases (10). The "gray" water samples contain an appreciable fraction of larger sized particles as is indicated by stronger absorbance at longer wavelengths than that for the other sample types. This absorbance would mask the absorbance of the smaller fraction of small particles and therefore would not give the same visual appearance.

Conclusions.

1. A major cause of "green water" along the north shore is tailings suspended in the water.

2. Not all green water masses occurring in Lake Superior are due to tailings.

3. Water clarity in green water, caused by tailings, is 4 to 10 times less than clarity in clear water.

4. The color is due to reflected light from suspended particles.

TABLE 1. Results of Suspended Solids Analyses of Reserve Mining Co. Effluent and North Shore Strea

Collection Date (1968)	Sample No.	Sample Location	Collection Depth (ft)	Suspended Solids (mg/l)	Mineralogical Composition*				
					Cummingtonite (Grunerite)	Quartz	Chlorite-Vermiculite	Mica	Other
		"Tailings" and Gray Water Near Effluent							
9/9	5	Reserve Mining Pilot Plant Raw Mill Eff.	-	1600	+++	++	+	Tr	-
9/9	5a	Effluent (5) - <2μ fraction	-	980	+++	++	+	-	-
9/9	5b	Effluent (5) - 2-50μ fraction	-	440	++	+++	+	-	-
9/16	3	Reserve's Is. out 50 ft.	50	59.4	+++	++	+	-	-
9/19	7	Eff. Delta out 100 ft.	100	92.2	++	+++	-	-	-
		North Shore Streams							
10/1	19	Big Manitou River (Mouth)	Surface	92.3**	Tr	+++	Tr	Tr	+++ Feldspar
10/1	21	Baptism River (Mouth)	Surface	4.3**	Tr	-	++	+	+ Kaolinite
9/24	16	Beaver R. (Mouth)	Surface	5.4	-	-	+++	++	+ Kaolinite
10/1	23	Beaver R. (Mouth)	Surface	2.6**	-	-	Tr	-	Tr Kaolinite
10/1	25	Split Rock R. (Mouth)	Surface	7.4**	-	+++	Tr	-	+ Kaolinite + Feldspar
10/1	27	Gooseberry R. (Mouth)	Surface	190.8**	-	+++	+	Tr	++ Feldspar + Kaolinite

* Designations - +++ Major Component, ++ Minor Component, + Minor to Trace, Tr - Trace only, - not detected.

** Includes resuspended bottom sediments.

TABLE 2 - Results of Suspended Solids Analyses of Water Samples from Lake Superior

Collection Date (1968)	Sample No.	Sample Location	Collection Depth (ft)	Suspended Solids (mg/1)	Mineralogical Composition*				
					Cummingtonite (Grunerite)	Quartz	Chlorite-Vermiculite	Mica	Other
		"Clear" Lake Water							
10/11	33	Shovel Pt. 1/2 Mi. out	60'	0.1	-	None Identified	-	-	-
10/1	20	1 Mi. N.E. Mouth Manitou R. @ Shoreline	Surface	0.4	-	None Identified	-	-	-
10/1	22	Just S. of Baptism R. @ Shoreline	Surface	0.4	-	+	-	-	Tr Feldspar
9/16	1	Palisades 1/2 Mi. out	50'	0.8	++	+	Tr	-	-
9/19	10	Palisades 1/2 Mi. out	60'	0.9	+	+	Tr	+	-
9/20	12	3 Mi. out from Silver Bay	60'	0.1	Tr	-	-	Tr	-
9/26	14	5 Mi. out from Silver Bay	Surface	0.7	Tr	Tr	-	-	-
		"Green" Water							
9/19	9	50' off Reserve Mining Co. S.W. Breaker	60'	2.0	+++	++	+	-	-
10/1	24	N.E. of Beaver R. in Bay @ Shore	Surface	2.0	+++	++	+	-	-
9/16	4	1 Mi. S. of Beaver Pt.	12'	3.7	+++	++	+	-	-

TABLE 2. (continued) Results of Suspended Solids Analyses of Water Samples from Lake Superior

Collection Date (1968)	Sample No.	Sample Location	Collection Depth (ft)	Suspended Solids (mg/1)	Mineralogical Composition*				
					Cummingtonite (Grunerite)	Quartz	Chlorite-Vermiculite	Mica	Other
		"Green Water"							
9/19	8	3-1/4 Mi. S. Eff. Delta	60'	2.7	+++	++	+	-	-
9/25	13	3-1/2 Mi. S.W. Eff. Delta	Surface	2.7	+++	++	+	-	-
9/24	17	Split Rock Lths. Bay	Surface	2.6	+++	++	+	-	-
9/24	18	Split Rock Lths. Bay	30'	3.3	+++	++	+	-	-
10/1	26	Split Rock Resort, 1/2 Mi. S.W. of Split Rock R. @ Shore	Surface	0.9	++	+	+++	+	Tr Kaolinite
9/27	15	Midway Between Split Rock & Gooseberry R.	Surface	1.4	+++	+	+	Tr	Tr Kaolinite
10/1	28	Just N.E. of Gooseberry R. @ Shore	Surface	1.2	+++	+	+	-	Tr Kaolinite
10/8	32	1/2 Mi. out from Crow Creek	Surface	0.8	+++	+	+	Tr	Tr Kaolinite
10/8	31	1/2 Mi. out from Crow Creek	60'	0.5	+++	+	+	Tr	Tr Kaolinite

* Designations - +++ Major Component, ++ Minor Component, + Minor to Trace, Tr - Trace only, - not detected.

FIGURE 1

X RAY DIFFRACTION PATTERNS OF SOLIDS FILTERED FROM TAILINGS EFFLUENT AND "GREEN WATER."

a.) Effluent Cloud out 50 ft. from Island.
(No. 3 - Table 1) 9/16/68. 250 ml., 59.4 mg/l.

b.) "Green Water" - Split Rock Lighthouse Bay.
(No. 18 - Table 2) 9/24/68, 2,000 ml., 3.3 mg/l.

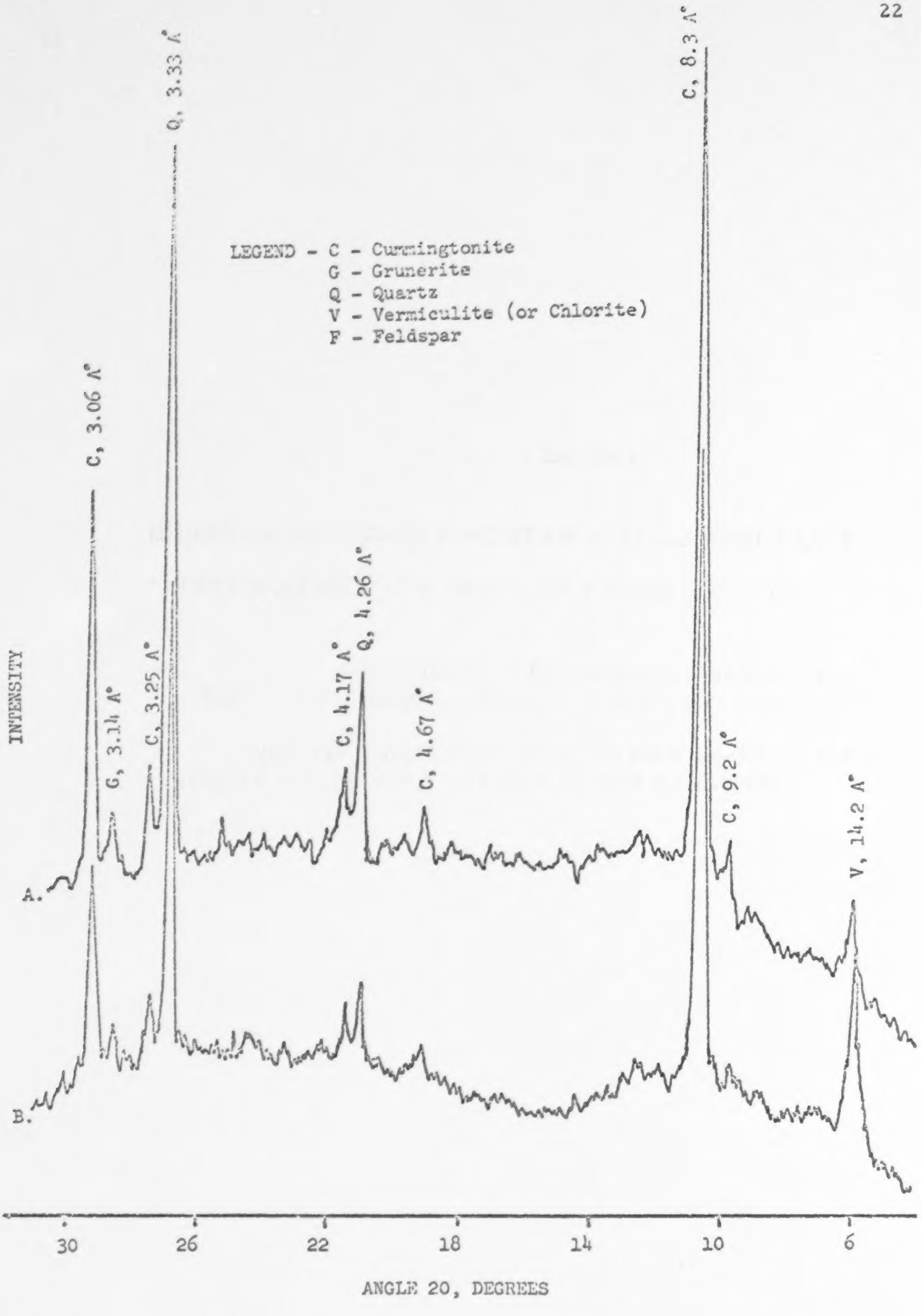
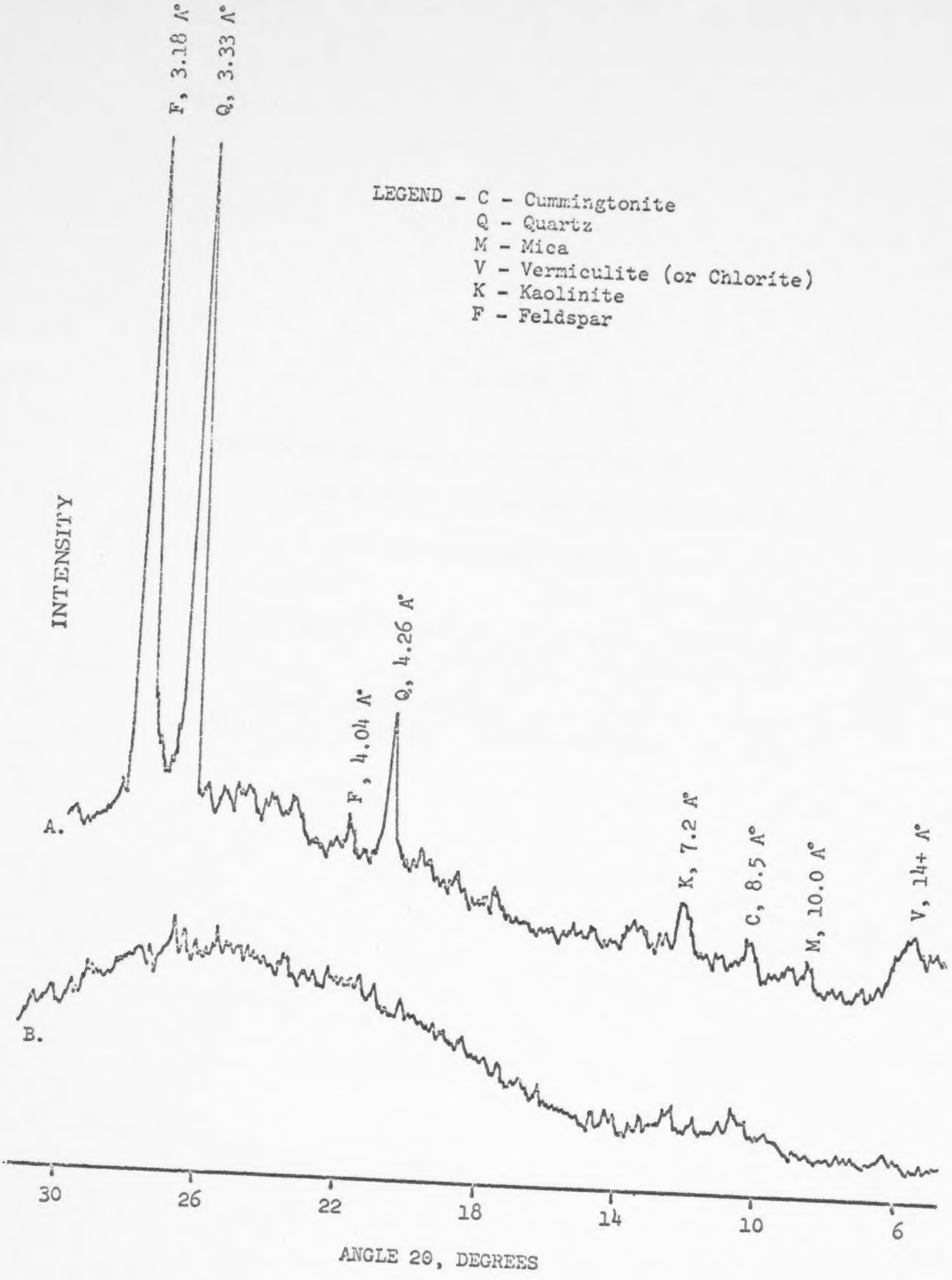

LEGEND - C - Cummingtonite
G - Grunerite
Q - Quartz
V - Vermiculite (or Chlorite)
F - Feldspar
Q, 3.33 Å
C, 8.3 Å
C, 3.06 Å
G, 3.14 Å
C, 3.25 Å
C, 4.17 Å
Q, 4.26 Å
C, 4.67 Å
C, 9.2 Å
V, 14.2 Å
INTENSITY
A.
B.
30
26
22
18
14
10
6
ANGLE 2θ, DEGREES

FIGURE 2

X RAY DIFFRACTION PATTERNS OF SOLIDS FILTERED FROM BIG MANITOU RIVER WATER AND "CLEAR" LAKE SUPERIOR WATER

a.) Big Manitou River at Mouth (No. 19 - Table 1), 10/1/68. 500 ml., 92.3 mg/l.

b.) "Clear" Water 5 Miles out from Effluent Delta. (No. 14 - Table 2) 9/26/68, 3,000 ml., 0.7 mg/l.


F, 3.18 A°
Q, 3.33 A°
LEGEND - C - Cummingtonite
Q - Quartz
M - Mica
V - Vermiculite (or Chlorite)
K - Kaolinite
F - Feldspar
INTENSITY
F, 4.04 A°
Q, 4.26 A°
K, 7.2 A°
C, 8.5 A°
M, 10.0 A°
V, 14+ A°
A.
B.
30
26
22
18
14
10
6
ANGLE 2θ, DEGREES

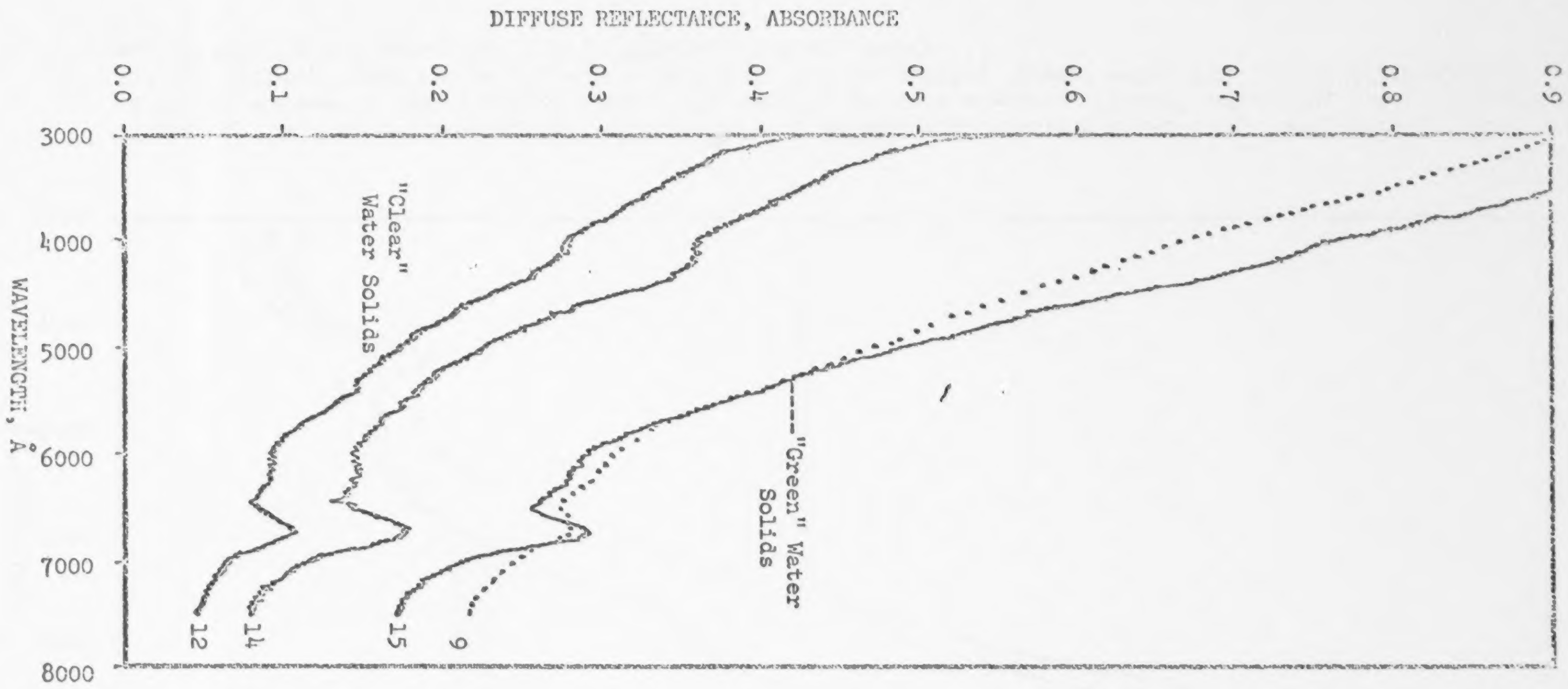


Figure 3. Diffuse reflectance (visible) spectra of solids from 3 liter samples of Lake Superior water, collected on 0.45 u Millipore filters. The spectra are from samples: "clear" water #12, 3.0 l. filtered, 0.4 mg. solids; "clear" water #14, 3.0 l. filtered, 2.1 mg. solids; "green" water #15, 2.9 l. filtered, 3.7 mg. solids; "green" water #9, 3.0 l. filtered, 6.1 mg. solids.

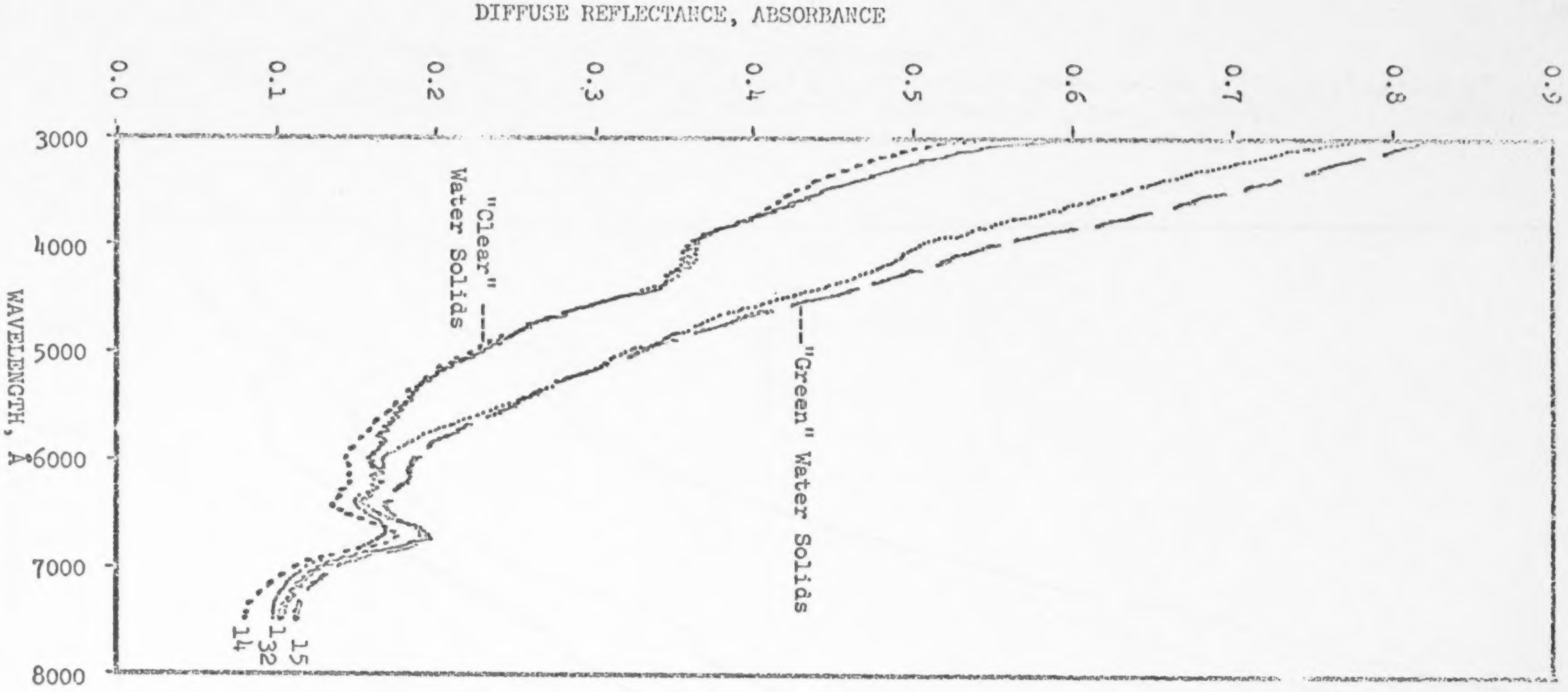


Figure 4. Diffuse reflectance (visible) spectra of solids, approximately 2.1-3.1 mg. each, filtered from different volumes of Lake Superior water. The spectra are from samples: "clear" water #14, 3.0 l. filtered, 2.1 mg. solids; "clear" water #1, 4.0 l. filtered, 3.1 mg. solids; "green" water #32, 3.0 l. filtered, 2.3 mg. solids; "green" water #15, 2.9 l. filtered, 2.6 mg. solids.

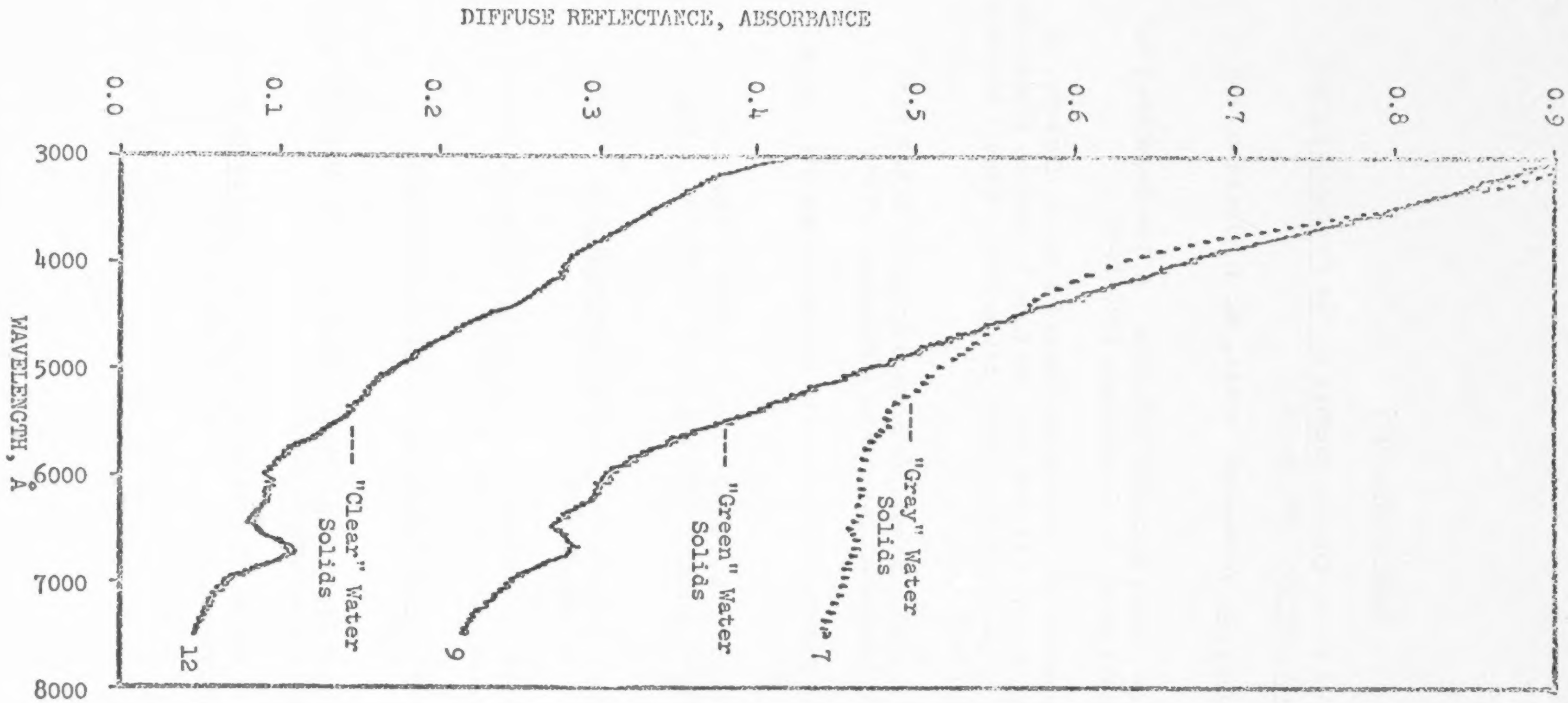


Figure 5. Diffuse reflectance (visible) spectra of solids filtered from Lake Superior water. The spectra are from samples: "clear" water #12, 3.0 l. filtered, 0.4 mg. solids; "green" water #9, 3.o l. filtered, 6.1 mg. solids; "gray" water #7, 0.5 l. filtered, 46.1 mg. solids.

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Distribution of Taconite Tailings
in the Sediments of the
Western Basin of Lake Superior

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Investigations by the Staff of

The National Water Quality Laboratory

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INTRODUCTION

Analysis of dredge samples collected in April 1969 from the western basin of Lake Superior revealed the presence of cummingtonite in the surface layers of the bottom sediment. Data presented at the May 1969 Lake Superior Enforcement Conference showed that cummingtonite is a major mineral constituent of taconite tailings discharged into the lake by the Reserve Mining Company at Silver Bay, Minnesota and also that cummingtonite is present in the suspended solids in water samples collected from green water areas near the point of discharge. No other discharge, man made or otherwise, exists that would contribute significant quantities of cummingtonite to the bottom sediments of Lake Superior. In addition, as will be shown in this report, contributions from the streams tributary to Lake Superior are insignificant in comparison. Identification of the taconite tailings in the bottom sediments would be positive if cummingtonite were present in a stratified layer in the upper part of the bottom sediment cores from Lake Superior. Since the discharge of taconite tailings to the lake began only recently, geologically speaking, one would expect to find tailings (and/or cummingtonite) only in the upper more recently deposited layers of bottom sediment. On the other hand, if the cummingtonite, used as an indication of tailings, occurred uniformly throughout the sediments, then the source of the cummingtonite would not be man made. Low concentrations of cummingtonite in the tributary stream sediments is strong supporting evidence that the Reserve Mining Company discharge is the primary source of cummingtonite in the bottom sediments of Lake Superior.

The primary objective of the present study is to determine the areal extent and depth of deposition of cummingtonite in the bottom sediments of Lake Superior as an indication of the deposition of taconite tailings. Coring and identification techniques would also be useful to state and other agencies for the study and assessment of similar waste disposal problems.

Sampling Methods

As shown in Figure 1,bottom sediment cores were collected during July 1969 from four transects in the western end of Lake Superior. Ten equidistant sampling stations were located on each transect, between the 13 fathom (80 foot) depth contour at either end of each transect (Figure 1). Four additional samples were collected, two in a line off the water supply intake of the city of Duluth and two others within the area indicated by Reserve Mining Company and the U.S. Geological Survey as overlain by 0.1 inch or more tailings deposits. Locations of the sampling stations are accurate to approximately 0.2 mile. The Bureau of Commercial Fisheries vessel, Siscowet, equipped with radar and other conventional navigational aids, was used for the cruise.

The sediment cores were collected by use of a Phleger core sampler with an internal diameter of 1 3/8 inches (3.5 cm). Two cores were collected at each station. Immediately after collection, the cores (contained in plastic tubes) were assigned a code number and quick-frozen, in dry ice. Attempts to section and study the cores immediately upon collection (e.g. pH measurements) proved impractical because of space and time limitations on board the research vessel.

In addition to the cores, samples were collected of the bottom sediments in the major tributary streams entering the western basin of the lake. These stream sediments were collected near the mouth at each of the streams as indicated by open circles on Figure 1. These samples were collected with an

Ekman dredge from a quiet pool or "eddy" area where fine sediments would be expected to accumulate. All samples were collected between May and September 1969,sufficiently upstream from any influence of lake wave action and all Minnesota stream samples were collected upstream from Highway 61 to avoid possible influence of tailings used for winter ice control.

X-ray diffraction analysis was used for the mineralogical assay of sediment samples. Prepared sediment samples were filtered, dried on 0.45μ membrane filters, and mounted on glass microscope slides for x-ray diffraction analysis. The samples were analyzed using copper K alpha radiation, and scanned at 2°/min over the range of 4 to 30°. Diffraction peaks were recorded by use of a scintillation detector, peak height discriminator and rate meter recorder.

Cores were first analyzed rapidly to provide an overview of all sampling stations. Then detailed analytical data were obtained on cores from stations in primary areas of deposition. For the preliminary analysis, one core from each station was selected at random, sectioned and analyzed without the analyst knowing the identity of the sample. Samples for this part of the study were prepared by suspending approximately 100 mg of the sediment in 100 ml distilled water and allowing the suspension to settle for 33 minutes at a temperature of 25° C in order to separate the <5μ fraction. The upper 5 cm of the suspension was then filtered through a pre-weighed 0.45μ pore-size membrane filter. The filters were dried at 70° C, weighed and the weight of solids calculated. The solids retained on the filter by this procedure contained particle sizes ranging from approximately 0.45 to 5μ. No other chemical or physical pretreatments were made prior to the x-ray diffraction analysis.

For the final analyses, individual sediment layers in the core were selected, based on a visual observation of sediment colors. Where no color differentiation was observed, cores were sectioned at 0.5 cm intervals or less. Approximately 100 mg samples of each of the upper four sections of the core were prepared for x-ray analysis in the following manner:

1. Organic matter and manganese dioxide were removed by hydrogen peroxide oxidation.
2. Iron oxide coatings were removed by reduction and chelation with sodium dithionite-sodium citrate buffer at 75° C.

3. Separation of the <2μ (clay) fraction was made by repeated centrifuging and resuspension.
4. The separated <2μ (clay) fraction was filtered and weighed on 0.45μ membrane filters, as previously described.

The method of standard additions was used for the quantitative analysis of cummingtonite (by x-ray diffraction) in the sediment samples from the cores. To a predetermined volume of the suspension of each sediment sample to be analyzed a volume of a suspension containing a known concentration of cummingtonite <2μ in size was added, such that the total solids collected on the 0.45μ membrane filter was 25±2 mg. A similar filter was prepared with the suspension of the sample without added standard cummingtonite. The membrane filters thus prepared (with and without standard cummingtonite) were scanned twice from 8 to 14° 2 θ on the x-ray diffraction instrument. The difference in heights of the cummingtonite peaks for the two samples was measured and used to calculate the cummingtonite content of each sample.

RESULTS AND DISCUSSION

The results of the analysis of the stream sediments from the stream tributary to the western basin of Lake Superior are shown in Table 1. The average cummingtonite content of the fifteen stream sediments sampled was 1.74±0.63%*. Since the reported values for cummingtonite in Table 1 include natural variation in cummingtonite content of the sediments and the analytical error associated with sample collection and analysis, the data can be used statistically to estimate the range of cummingtonite contents that would be expected in the bottom sediments of the lake assuming that the tributary streams are the primary source of cummingtonite.

Results for the detailed analysis of the lake sediment cores are shown in Table 2a - 2e. In order to compare results of the core analyses with the cummingtonite contents of the natural stream sediments, a stepwise statistical analysis was performed. A Student's T range test was used to define those cores where the deepest sample in the core (the oldest sediment) was within the predicted range of the stream sediments. Samples with cummingtonite greater than 2.87% were considered outside this range. In Figure 2, the stations indicated by open circles are those where the deepest section in the core is within the statistical range predicted from the stream sediment data. The stations shown by solid circles on this map are those where the lowermost section in the core is greater than the range predicted from the stream sediment data and are from a source other than the tributary streams. The average cummingtonite content of the samples within the range of those predicted from the stream sediments was then calculated and found to be 1.95±0.57%.[**] This value approximates the mean and range of cummingtonite content in the natural bottom sediments of the lake.

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* Range equals Standard Deviation.

The same test was used to determine which upper sections of the cores were outside the range of the natural bottom sediments. The samples outside the expected range of natural sediments[***] in the lake are identified by an asterisk

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[*] Least significant difference, Student's 95% level.
[**] Range equals < Standard Deviation.
[***] Least significant difference, Student's 99% level equals 3.46%.

in Tables 2a-2e. The distribution of these cores is shown in Figure 3 and illustrates the distribution of tailings in the lake. Since the <2μ fraction of the taconite tailings contains approximately 40% cummingtonite, the cummingtonite percentages in Tables 2a-2e can be converted to % tailings by deducting 3.5% (the maximum expected for natural sediments) and multiplying the remainder by 2.5. The data in Tables 2b and 2e are plotted in Figures 4 and 5. In these figures the depth distribution of cummingtonite in the cores is shown in inset figures superimposed on cross-sectional profiles of the lake. The station locations and the water depth in fathoms are shown in cross-sectional view. These figures show that most of the tailings (as reported earlier in the conference proceedings) are deposited in the deep trough parallel to the north shore of Lake Superior. They also show deposition of fine tailings over large areas and although deposition is predominant in, it is not confined to, the deep water but rather occurs over most of the area West and South of the Apostle Islands. The distribution pattern of the tailings becomes discontinuous eastward along the Wisconsin shore. The predominant lake currents are rather stable and move in a counterclockwise direction; the highest percentage and greatest thickness of taconite tailings occur southwest of the plant in the deeper water, and lesser amounts occur at greater distances from the discharge. Because of wave action, and especially dilution by tributary stream sediments from the northwestern shore of Wisconsin, the tailings deposits in the bottom sediments become discontinuous with distance from the discharge.

The relatively high percentages of cummingtonite at stations 20 and 42 on the Wisconsin shore suggest that wave action and/or current conditions cause the taconite tailings to deposit relatively close in shore on the Wisconsin side of the lake.

Summary

1. Taconite tailings from the Reserve Mining Company at Silver Bay, Minnesota are deposited discontinuously on the surface of the lake bottom over an area of at least 1,000 square miles in the western tip of Lake Superior.
2. The tailings are mixed in the top 5-10 cm of sediment.
3. The percentage of cummingtonite in tributary stream sediments

accurately indicates the cummingtonite content found in the subsurface bottom sediments.

4. Tailings deposits are found in both Minnesota and Wisconsin waters. Although the sediments in Wisconsin waters contain very low percentages of taconite tailings, the tailings deposits are distinguishable quantitatively from stream sediments.

Table 1. Results of x-ray diffraction analysis for cummingtonite in stream sediment samples.

Collection Date		Stream Sampled	% Cummingtonite (<2μ)
	Minnesota Tributaries		
9/16/69		Pigeon R.	2.05
9/16/69		Brule R.	2.43
5/ 2/69		L. Marais R.	2.05
5/ 2/69		Baptism R.	1.02
5/ 2/69		Beaver R.	1.25
5/ 2/69		Gooseberry R.	1.79
5/ 2/69		Knife R.	1.50
4/22/69		French R.	1.49
4/21/69		St. Louis R.	1.16
	Wisconsin Tributaries		
4/22/69		Nemadji R.	2.11
9/17/69		Nemadji R.	1.54
9/17/69		Bad R.	1.58
9/17/69		Sand R.	2.26
9/17/69		Siskiwit R.	0.68
9/17/69		Iron R.	3.15
		Mean	1.74
		Standard Deviation	0.63

Table 2a. Results of sediment core analysis, Silver Bay to Sand Island transect.

Sta.	Water Depth (Fath)	Total Core Length (cm)	Sample Depth in Core (mm)	% <2μ	% Cum. (<2μ)
11	13-20		No sample - Bedrock		
12	140		No sample - Bedrock		
13	160	9.7	0 - 5	-[a]	-
			5 - 15	-	-
			@97	-	-
14	110	59.8	0 - 5	-	-
			5 - 10	-	-
			10 - 20	-	-
			@100	-	-
15	100	26.3	0 - 10	76.0	2.43
			@15	77.5	2.61
			15 - 20	79.5	2.80
			35 - 40	79.4	1.72
16	95	20.7	23 - 38 [b]	73.9	3.32
			38 - 42	--- [c]	---
			42 - 45	75.3	3.50*
			@100	75.3	2.73
17	80	20.7	0 - 7	64.6	3.08
			7 - 11	72.7	1.53
			11 - 21	71.8	1.82
			21 - 24	71.9	3.56*
18	63	15.0	0 - 2	63.8	3.61*
			2 - 5	68.6	1.26
			5 - 10	67.9	1.10
			10 - 15	66.9	2.59
19	38	14.9	0 - 2	24.9	2.07
			2 - 4	23.5	2.03
			4 - 9	16.8	4.51*
			9 - 14	19.8	2.36
20	14	Dredge	0 - 10	<5	6.31*

[a] Analysis incomplete.

[b] Partially disturbed core. Original top of core sampled as closely as possible.

[c] Sample lost in preparation.

* Cummingtonite content outside statistical range for natural sediments. See text for explanation.

Table 2b. - Results of sediment core analysis, Encampment Island to Herbster transect.

Sta.	Water Depth (Fath.)	Total Core Length (cm)	Sample Depth In Core (mm)	% <2µ	% Cum. (<2µ)
30	14	15.2	0 - 2	11.2	26.2*
			2 - 4	10.2	23.9*
			4 - 9	10.0	12.3*
			9 - 14	8.4	6.15*
29	122	9.0	0 - 7	30.0	29.6*
			7 - 10	55.2	10.7*
			10 - 15	71.1	6.41*
			20 - 25	72.1	2.37
28	138	12.4	0 - 8	38.5	14.7*
			8 - 10	70.8	2.80
			10 - 15	79.0	3.11
27	102	6.5	0 - 5	71.5	2.17
			5 - 10	69.3	2.59
			10 - 20	76.8	1.73
			35 - 40	75.3	2.96
26	87	31.0	0 - 2	62.2	5.17*
			2 - 10	69.3	2.22
			10 - 15	71.6	1.90
			15 - 20	73.0	1.58
25	82	11.5	0 - 6	66.8	2.18
			6 - 9	74.2	0.73
			9 - 15	69.8	0.74
			35 - 40	70.8	2.24
24	68	29.5	0 - 2	71.0	1.15
			2 - 5	71.3	1.53
			5 - 15	71.6	2.12
			15 - 20	70.5	0.99
23	57	18.5	0 - 5	66.7	0.98
			5 - 10	66.3	1.80
			10 - 25	63.3	1.66
			25 - 30	64.8	1.85
22	48	23.7	0 - 1	38.1	3.11
			1 - 2	43.7	2.51
			2 - 3	38.0	1.65
			3 - 4	52.1	1.75
21	15	Dredge	0 - 10	<5	2.84

* Cummingtonite content outside statistical range for natural sediments. See text for explanation.

Table 2c. - Results of sediment core analysis, Stoney Point to Brule River transect.

Sta.	Water Depth (Fath.)	Total Core Length (cm)	Sample Depth in Core (mm)	%<2µ	% Cum. (<2µ)
33	14	-	No Sample - Bedrock		-
34	75	10.0	0 - 2	40.7	28.9*
			2 - 5	38.4	16.8*
			5 - 10	42.8	3.81*
35	55	19.0	0 - 5	40.3	13.8*
			5 - 7	41.4	12.6*
			7 - 12	43.5	7.96*
			12 - 17	45.9	4.57*
36	43	22.4	0 - 2	45.2	11.1*
			2 - 4	45.6	5.56*
			4 - 9	48.8	2.80
			9 - 14	46.6	1.62
37	39	18.7	0 - 5	53.9	8.37*
			5 - 10	48.3	2.32
			10 - 15	49.4	1.87
			30 - 35	51.5	1.81
38	36	21.7	0 - 10	47.3	1.60
			10 - 12	46.5	2.17
			12 - 19	51.6	2.89
			19 - 29	52.4	1.52
39	32	30.5	0-27a	47.1	1.97
			27 - 40	19.7	2.67
			27 - 40	21.7	2.40
			27 - 40	44.3	2.20
40	27	7.0	0 - 5	6.4	4.36*
			5 - 10	8.6	2.70
			10 - 15	7.6	2.73
			15 - 20	7.2	2.15
41	17	3.0	0 - 5	7.2	3.85*
			5 - 10	8.8	2.26
			10 - 15	6.6	2.07
			15 - 20	7.2	0.80
42	12	Dredge	0 - 10	<5	7.45*

a Partially disturbed core. Original top of core sampled as closely as possible.

* Cummingtonite content outside statistical range for natural sediments. See text for explanation.

Table 2d. - Results of sediment core analysis, Grand Marais to Ontonagon transect.

Sta.	Water Depth (Fath.)	Total Core Length (cm)	Sample Depth in Core (mm)	% <2µ	% Cum (<2µ)
1	15	Dredge	0 - 10	<5	0.21
2	65	20		-a	-
3	107	25		-	-
4	112	37.5		-	-
5	103	40		-	-
6	87	25		-	-
7	76	25	0 - 5	59.4	8.37*
			5 - 10	87.1	4.71*
			10 - 20	90.1	8.66*
			20 - 30	84.4	3.34
8	95	25		-	-
9	93	40		-	-
10	13	No Sample - Bedrock			

a Analysis incomplete.

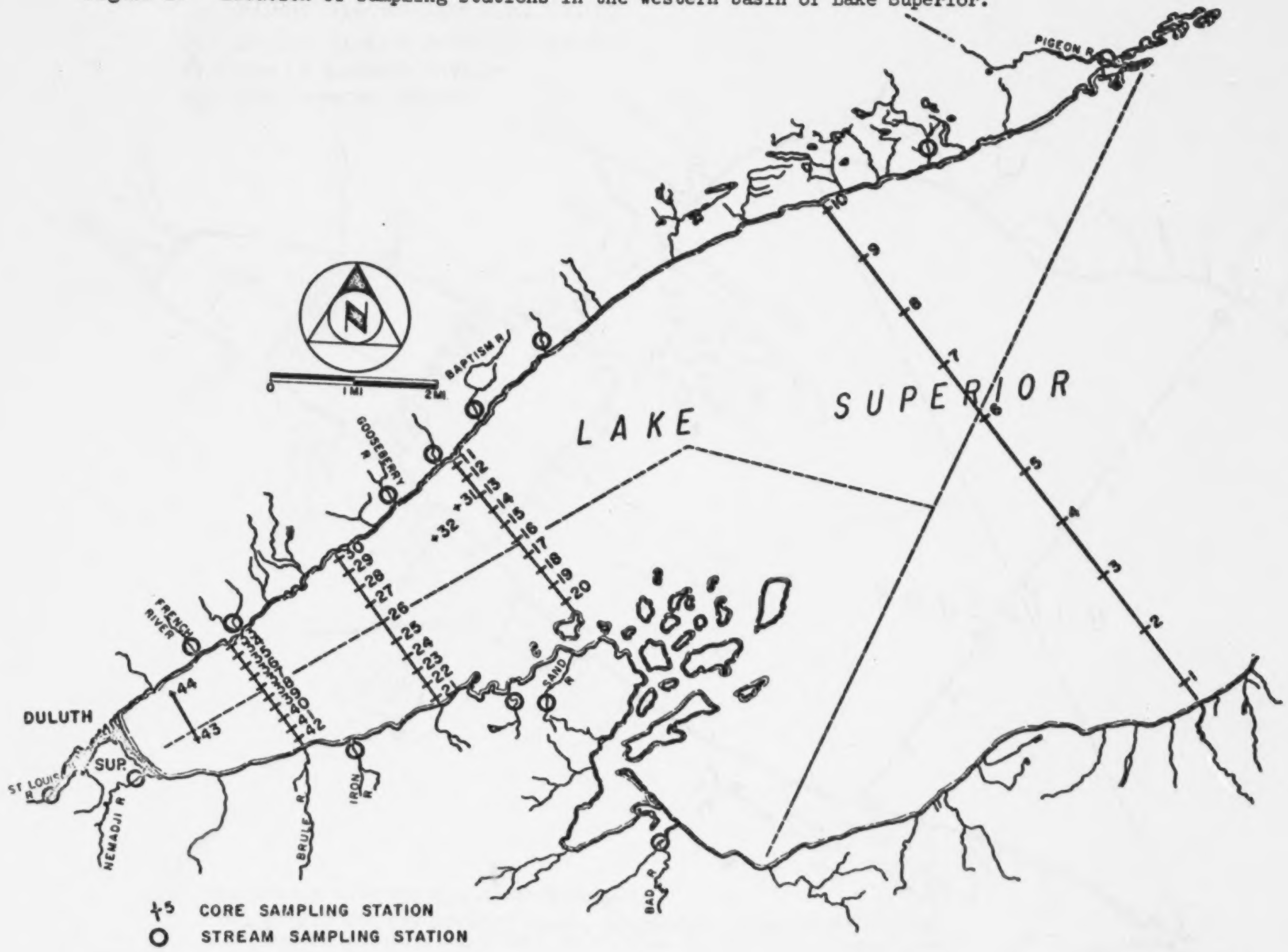
* Cummingtonite content outside statistical range for natural sediments. See text for explanation.

Table 2e. - Results of sediment core analysis, miscellaneous samples.

Sta.	Water Depth (Fath.)	Total Core Length (cm)	Sample Depth in Core (mm)	% <2μ	% Cum. (<2μ)
31	162	8.4	0 - 25	-a	-
32	152	20	used for development of sectioning methods		
43	19	12.9	0 - 5	-	-
			5 - 10	-	-
			10 - 20	-	-
44	24	23.3	0 - 5	-	-
			5 - 10	-	-
			15 - 20	-	-

a Analysis incomplete

Figure 1. - Location of sampling stations in the western basin of Lake Superior.


PIGEON R.
LAKE SUPERIOR
BAPTISM R.
GOOSEBERRY R.
FRENCH RIVER
DULUTH
SUP.
ST LOUIS R.
NEMADJI R.
BRULE R.
IRON R.
SAND R.
BAD R.
0
1 MI
2 MI
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
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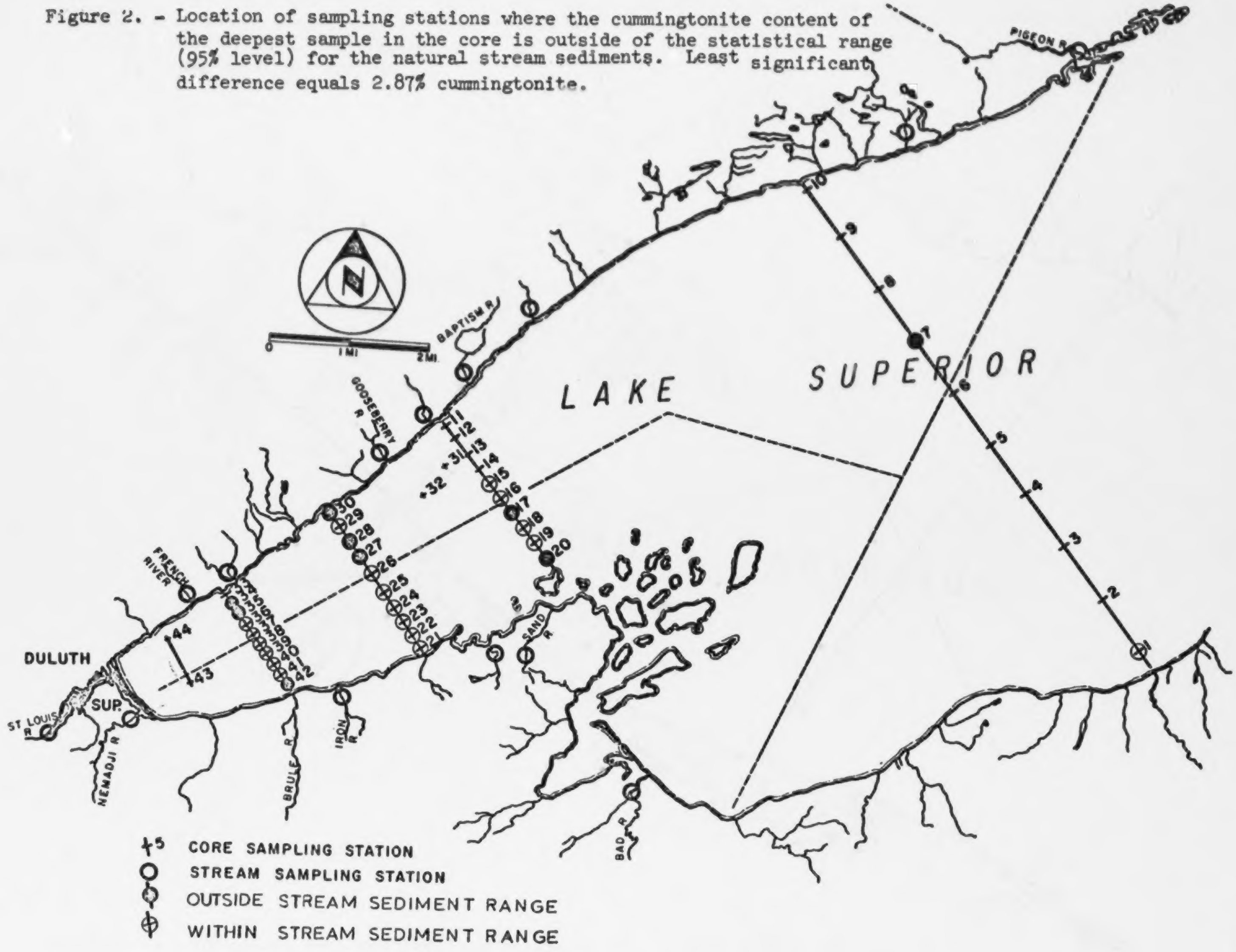
27
28
29
30
31
32
42
43
44
CORE SAMPLING STATION
STREAM SAMPLING STATION


PIGEON R
BAPTISM R
GOOSEBERRY R
FRENCH RIVER
DULUTH
SUP.
ST LOUIS R
NEMADJI R
BRULE R
IRON R
SAND R
BAD R
LAKE SUPERIOR
N
0
1 MI
2 MI
1
2
3
4
5
6
7
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9
10
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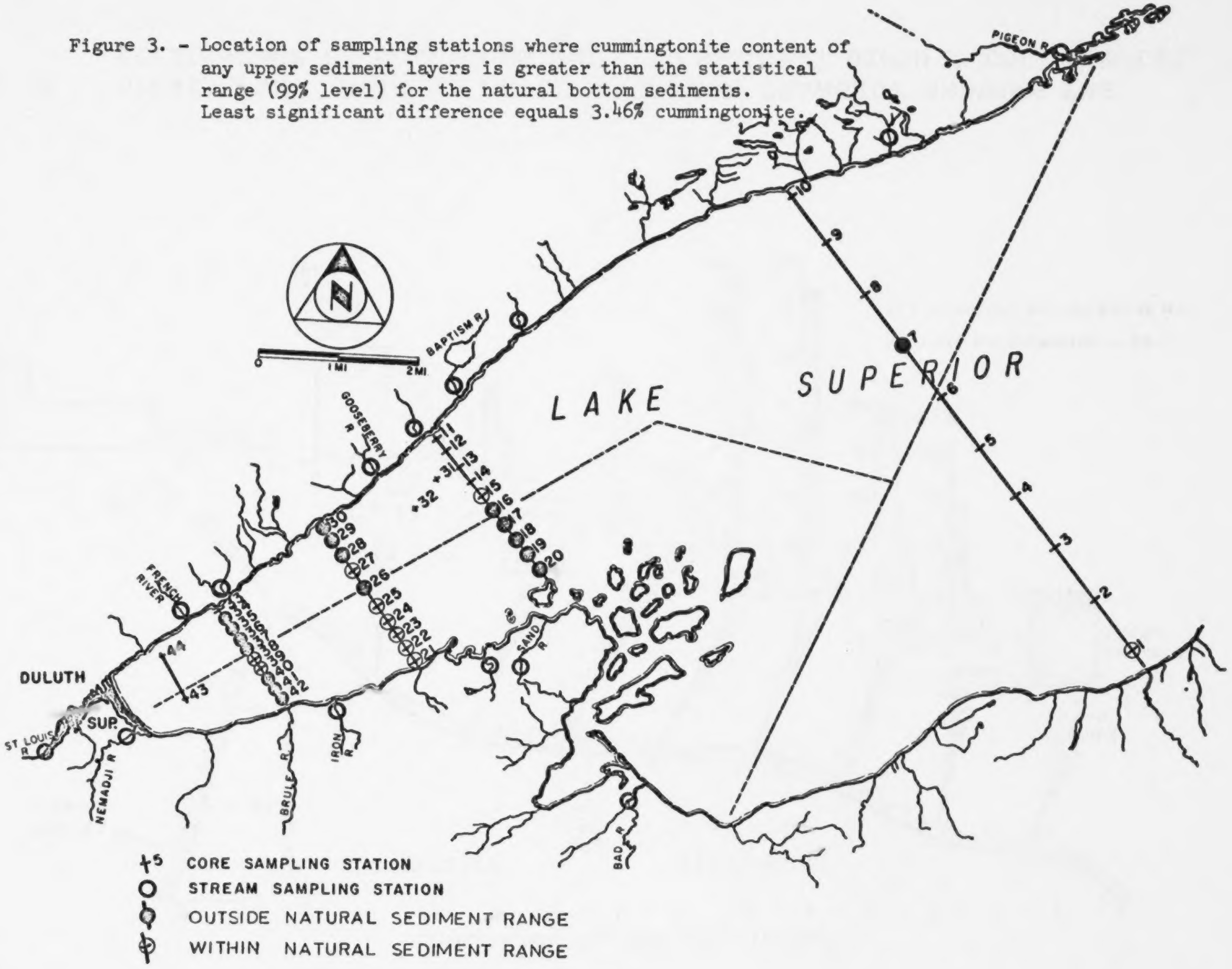
22
23
24
25
26
27
28
29
30
31
32
43
44
CORE SAMPLING STATION
STREAM SAMPLING STATION
OUTSIDE STREAM SEDIMENT RANGE
WITHIN STREAM SEDIMENT RANGE

Figure 2. - Location of sampling stations where the cummingtonite content of the deepest sample in the core is outside of the statistical range (95% level) for the natural stream sediments. Least significant difference equals 2.87% cummingtonite.

Figure 3. - Location of sampling stations where cummingtonite content of any upper sediment layers is greater than the statistical range (99% level) for the natural bottom sediments. Least significant difference equals 3.46% cummingtonite.


PIGEON R
BAPTISM R
GOOSEBERRY R
FRENCH RIVER
DULUTH
SUP.
ST LOUIS R
NEMADJI R
BRULE R
IRON R
SAND R
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44
5
CORE SAMPLING STATION
STREAM SAMPLING STATION
OUTSIDE NATURAL SEDIMENT RANGE
WITHIN NATURAL SEDIMENT RANGE

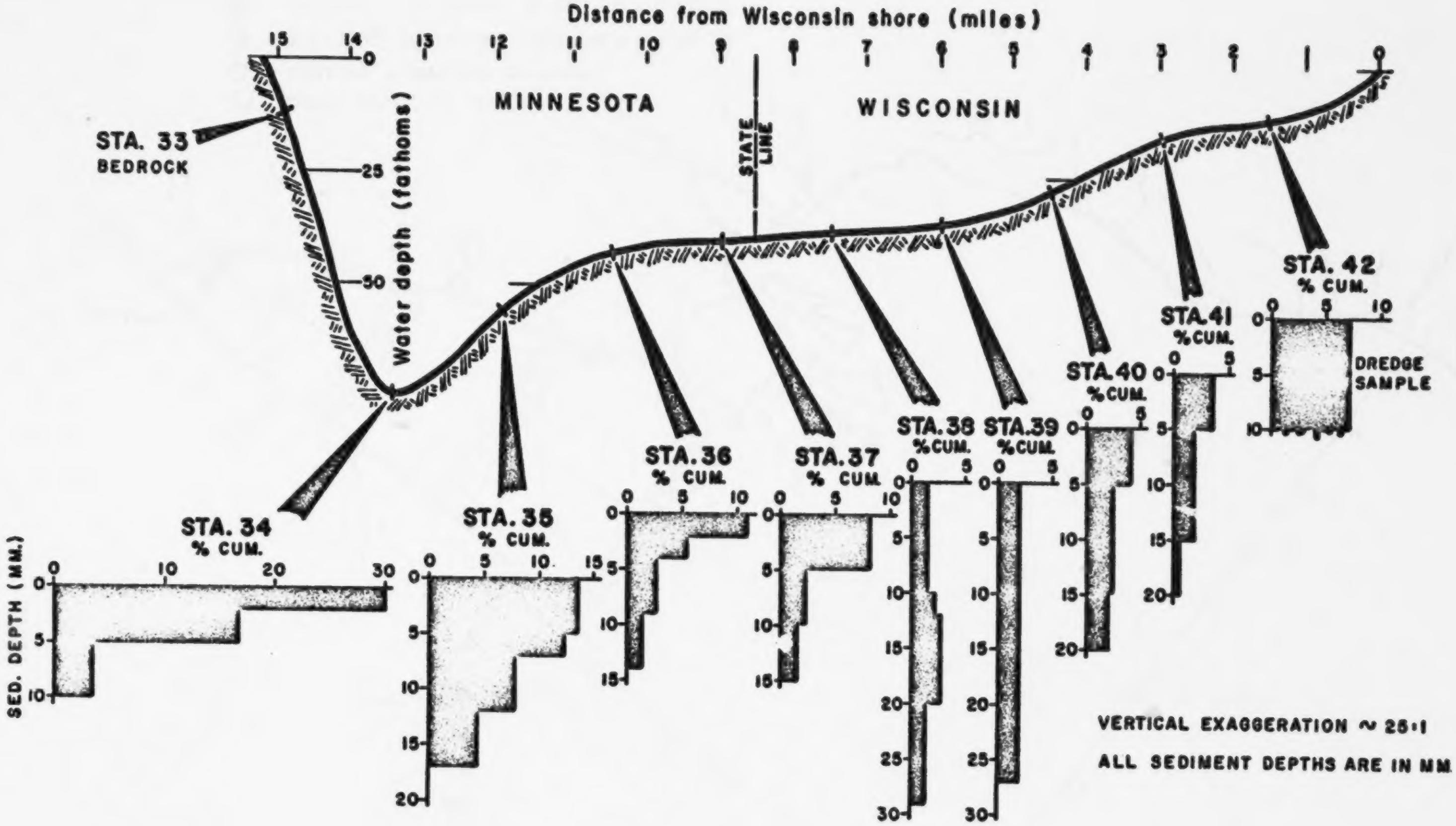


FIGURE 4. STONEY POINT, MINN. TO BRULE RIVER, WIS. TRANSECT SHOWING THE RELATIONSHIP OF % CUMMINGTONITE TO SEDIMENT DEPTH IN CORE SAMPLES.

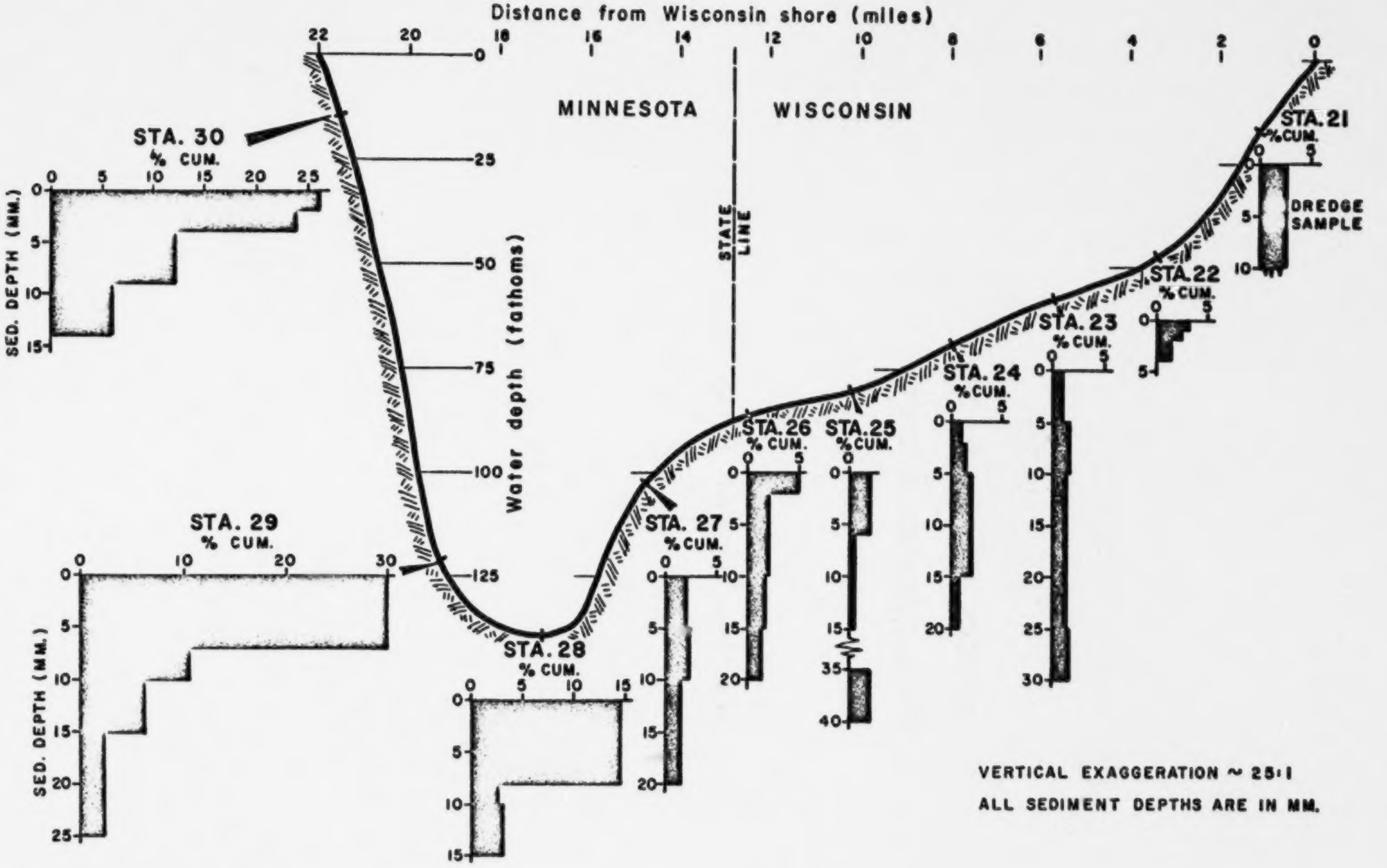


FIGURE 5. ENCAMPMENT ISLAND TO HERBSTER WIS. TRANSECT SHOWING THE RELATIONSHIP OF % CUMMINGTONITE TO SEDIMENT DEPTH IN CORE SAMPL

EFFECT OF TACONITE
ON BACTERIAL GROWTH

Donald L. Herman, Ph.D.

Introduction.

Bacterial counts in Lake Superior are strikingly low, a feature of the Lake that makes it one of the best water supplies in the nation. The discharge of taconite tailings by Reserve Mining Company has a potential effect upon the high quality water of Lake Superior which relates directly to the bacterial pollution already entering the Lake.

During the summer of 1969 field samples taken in green water, containing taconite, were found to have higher bacterial counts than samples of clear water from the same area of the Lake. This suggested biological activity of the taconite tailings (9, 11).

Tests were designed to determine in controlled conditions if tailings in lake water promote bacterial growth and, if so, at what concentrations. *E. coli* was selected as one test species because it is widely used as an indicator of pollution (12) and *Klebsiella pneumonia*, previously isolated from tributary water, was used as a representative pathogenic species. Evidence given by Mr. Edward Geldrich in the May 1969 session of the Lake Superior Enforcement indicated that the die away of pathogens as compared to *E. coli,* is much slower in cold temperatures than in warmer temperatures. This die away has significance for pollution control agencies because it means that the same number of indicator coliforms indicate different number of pathogens (7, 8, 10).

Methods.

The following organisms were used for the tests:

1. Escherichia coli, NWQL #234 from the Lake Superior area and of fecal origin.
2. Escherichia coli, CDC #435-70 from a Lake Superior tributary and of water origin.
3. Klebsiella pneumonia, type 14, CDC #6417-69 also from Lake Superior tributary water.

The isolations were made following the recommendations listed in Standard Methods (1, 2, 3, 4, 5, 6). Final classification at the National Water Quality Laboratory followed the protocol of "Identification of Enterobacteriaceae" (14) and the biotest based on Patho Tec Strips (13). The human pathogens from water were sent to the Communicable Disease Center, Atlanta, Georgia for confirmation.

The bacteria used as the test organism were placed in a sterile TSA broth tube. The tube was incubated for 24 hours at 200 rpm, at 35° C, in a shaker-type water bath. After the incubation period, one milliliter was placed into a sterile dilution bottle and a series of dilutions were made to obtain the desired inoculum population. This also washed free the nutrients from the TSA broth, leaving only the nutrient source from the taconite and/or lake water.

EMB agar, a selective media, was used to determine counts of E. coli. The organisms that developed a "green sheen" and/or dark centered colony, characteristic of the group, were counted.

Initial tests with E. coli showed no significant difference between total counts using TSA agar and EMB agar. The EMB agar assured better counts, minimizing confusion from contamination. The test organisms were incubated at 20° C for three days. "Standard Methods for Microbiology" (1, 2, 4) was used at all times during handling of the test organisms. During the test periods, picks from the plates were made and streaked on EMB plates and placed in the 35° C incubator to confirm the identity of the test organism (5). Tests were made in 125 ml flasks, sealed off during the test period to avoid air contamination. Control flasks containing filtered, sterilized Lake Superior water, inoculated and uninoculated, plus uninoculated 100% sterilized effluent served as controls. In all cases, these controls remained free of contamination for the entire test period.

Taconite effluent with <2 μ particle size (15) added to flasks plus sufficient filtered lake water to give a final volume of 100 ml was used. Concentrations of 100% (162 mg/l SS), 10% (16.2 mg/l SS), 1% (1.6 mg/l SS), and .1% (.16 mg/l SS) were tested. Triplicate flasks were used for each concentration. Flasks were then autoclaved for 15 minutes at 15 lbs. steam at 250° F, cooled and inoculated.

All flasks were incubated at 20° C and the "Standard Plate" method was used to count bacteria at 3, 5, 7, 9 and 11 days after inoculation. EMB agar plates were used for counting coliforms and the K. pneumonia.

Results and Discussion.

As shown in Table 1 and Figure 1, *E. coli* #234 exhibited a rapid die away in lake water, but extended survival in the .16 mg/l concentration. Concentrations of 1.6 mg/l and greater resulted in greatly enhanced growth. *E. coli* #435-70, Table 2, responded similarly in lake water and in the .16 mg/l concentration, but grew profusely at 1.6 mg/l and higher concentrations. *K. pneumonia*, Figure 2 and Table 3, likewise died away rapidly in lake water and .16 mg/l but grew well at 1.6 mg/l.

The statements made by Mr. Edward Geldrich and Dr. Graham Walton in the May 1969 Conference are substantiated by this experimental work. The data clearly show that concentrations of tailings of 1.6 mg/l (1%) or less promote growth and significantly reduce die away of bacteria of sanitary significance. Since green water has been shown to contain 1 - 2 mg/l of suspended solids (16), and in preliminary counts contained higher bacterial counts than clear water, the field and laboratory data compliment each other and definitely demonstrate biological activity and discredit the statement that tailings are inert.

Conclusions.

1. Tailings are biologically active at concentrations of approximately 1 mg/l--a concentration expected to occur over a significant area of the Lake.

2. The reduced die away or enhanced growth is displayed by indicators of fecal contamination, as well as a pathogenic bacterium.

Table 1. - Escherichia coli, NWQL #234 Response, in Organisms/ml, to Taconite Effluent (<2 µ particles) at 20° C

Days	Replicate Mean	Lake Water	100% (162 mg/l)	10% (16.2 mg/l)	1% (1.6 mg/l)	.1% (.16 mg/l)	Inoculum
0	1						2,000
	2						2,215
	3						1,815
	$\overline{m}$						(2,000)
3	1	17	93,000	11,500	32,900	1,400	
	2	20	95,000	12,000	34,500	1,200	
	3	14	87,000	9,400	31,000	1,700	
	$\overline{m}$	(17)	(92,000)	(11,000)	(33,000)	(1,400)	
5	1	9	120,000	38,400	61,000	1,700	
	2	7	122,000	36,200	59,000	2,200	
	3	11	117,000	41,500	67,200	2,000	
	$\overline{m}$	(9)	(120,000)	(39,000)	(62,000)	(2,000)	
7	1	1	84,100	32,400	47,000	1,365	
	2	2	78,900	33,000	51,000	1,455	
	3	1	87,500	28,700	41,000	1,275	
	$\overline{m}$	(1.3)	(84,000)	(31,000)	(46,000)	(1,400)	
9	1	3	59,100	38,000	54,000	1,700	
	2	4	58,000	37,200	53,000	1,900	
	3	2	55,700	25,500	45,000	1,500	
	$\overline{m}$	(3)	(58,000)	(34,000)	(51,000)	(1,700)	
11	1	<1	73,000	23,000	54,000	1,290	
	2	<1	69,000	28,000	59,000	1,400	
	3	<1	43,700	29,000	53,000	1,100	
	$\overline{m}$		(62,000)	(27,000)	(55,000)	(1,300)	

Table 2 - Escherichia coli, CDC #435-70 - Response, in Organisms/ml, to Taconite Effluent (<2 µ particles) at 20° C

Days	Replicate Mean	Lake Water	100% (162 mg/l)	10% (16.2 mg/l)	1% (1.6 mg/l)	.1% (.16 mg/l)	Inoculum
0	1						900
	2						1,165
	3						860
	$\overline{m}$						(1,000)
3	1	366	2,300	4,200	6,100	267	
	2	290	1,900	3,700	5,600	212	
	3	380	2,600	4,250	6,430	308	
	$\overline{m}$	(300)	(2,300)	(4,100)	(6,000)	(300)	
5	1	204	6,100	2,000	79,000	55	
	2	165	5,670	1,760	74,000	42	
	3	219	6,400	2,210	82,000	67	
	$\overline{m}$	(200)	(6,100)	(2,000)	(78,000)	(60)	
7	1	211	242,000	23,000	97,000	54	
	2	220	256,000	25,500	112,000	65	
	3	170	235,000	21,700	91,000	48	
	$\overline{m}$	(200)	(244,000)	(23,000)	(100,000)	(60)	
9	1	192	228,000	82,500	93,000	27	
	2	179	240,000	85,200	95,400	35	
	3	140	212,000	76,700	88,500	21	
	$\overline{m}$	(200)	(227,000)	(81,000)	(92,000)	(30)	
11	1	<1:100	266,000	68,000	73,000	11	
	2	27	273,000	72,000	69,000	18	
	3	32	260,000	64,000	78,000	9	
	$\overline{m}$	(30)	(266,000)	(68,000)	(73,000)	(15)	

Table 3. - *Klebsiella pneumonia* Type 14 CDC #6417 - 69 Response, in Organisms/ml, to Taconite Effluent (<2 μ particles) at 20° C

Days	Replicate Mean	Lake Water	100% (162 mg/l)	10% (16.2 mg/l)	1% (1.6 mg/l)	.1% (.16 mg/l)	Inoculum
0	1						3,000
	2						2,789
	3						3,275
	$\overline{m}$						(3,000)
3	1	<1	135,500	39,400	200	<1	
	2	<1	137,000	41,000	187	<1	
	3	<1	129,000	36,200	222	<1	
	$\overline{m}$		(134,000)	(39,000)	(200)		
5	1	<1	500,000	290,000	1,500	<1	
	2	<1	520,000	310,000	1,800	<1	
	3	<1	470,000	265,000	1,300	<1	
	$\overline{m}$		(497,000)	(288,000)	(1,500)		
7	1	<1	290,000	330,000	24,200	<1	
	2	<1	280,000	345,000	23,000	<1	
	3	<1	310,000	317,000	26,000	<1	
	$\overline{m}$		(293,000)	(331,000)	(24,000)		
9	1	<1	678,000	371,000	45,400		
	2	<1	507,000	331,500	34,000		
	3	<1	548,000	365,000	42,500		
	$\overline{m}$		(578,000)	(356,000)	(41,000)		

FIGURE 1. *Escherichia coli*, NWQL #234, Response,
in Organism/ml, to Taconite Effluent
(<2 μ particles) at 20° C

61

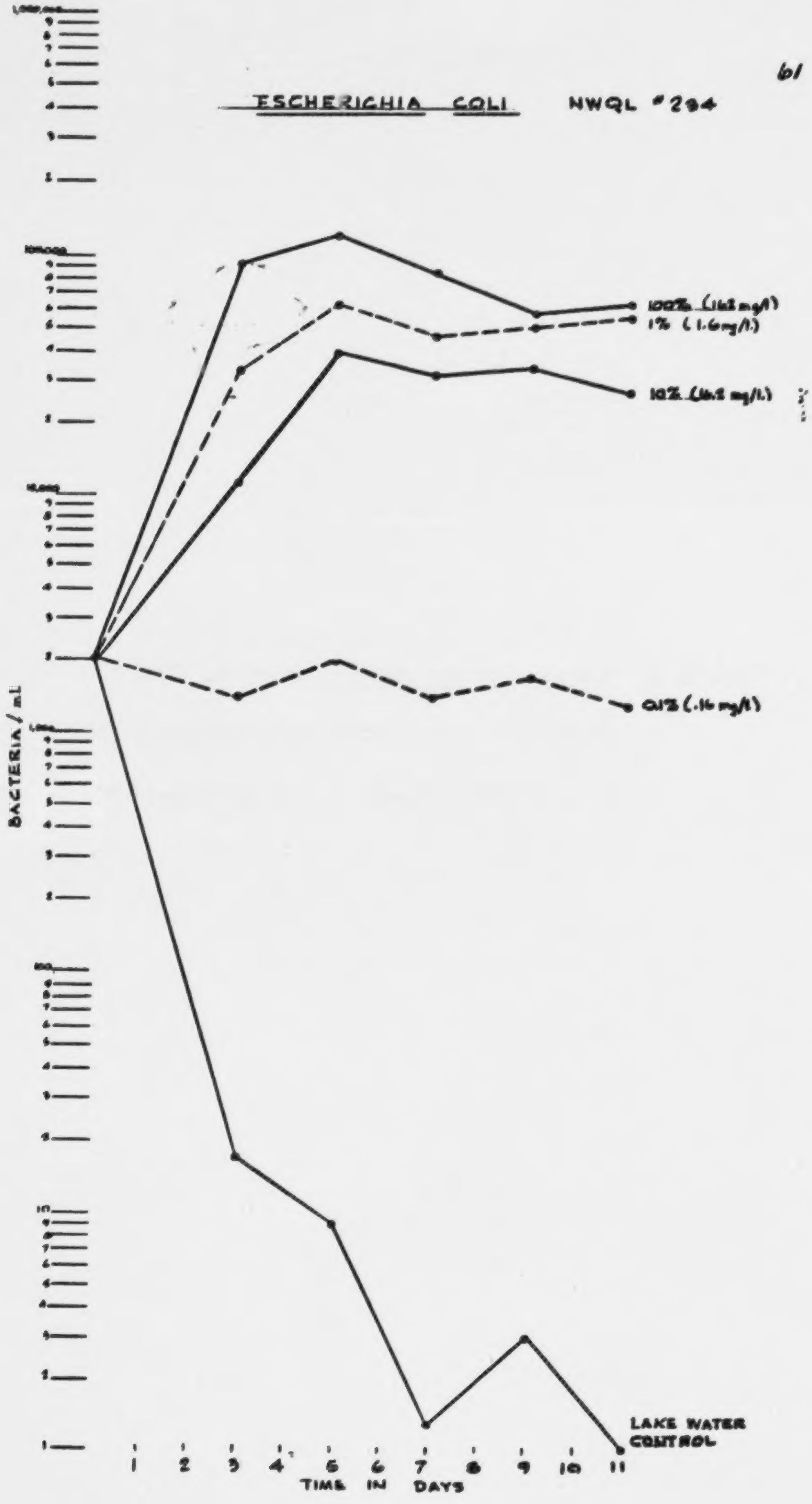
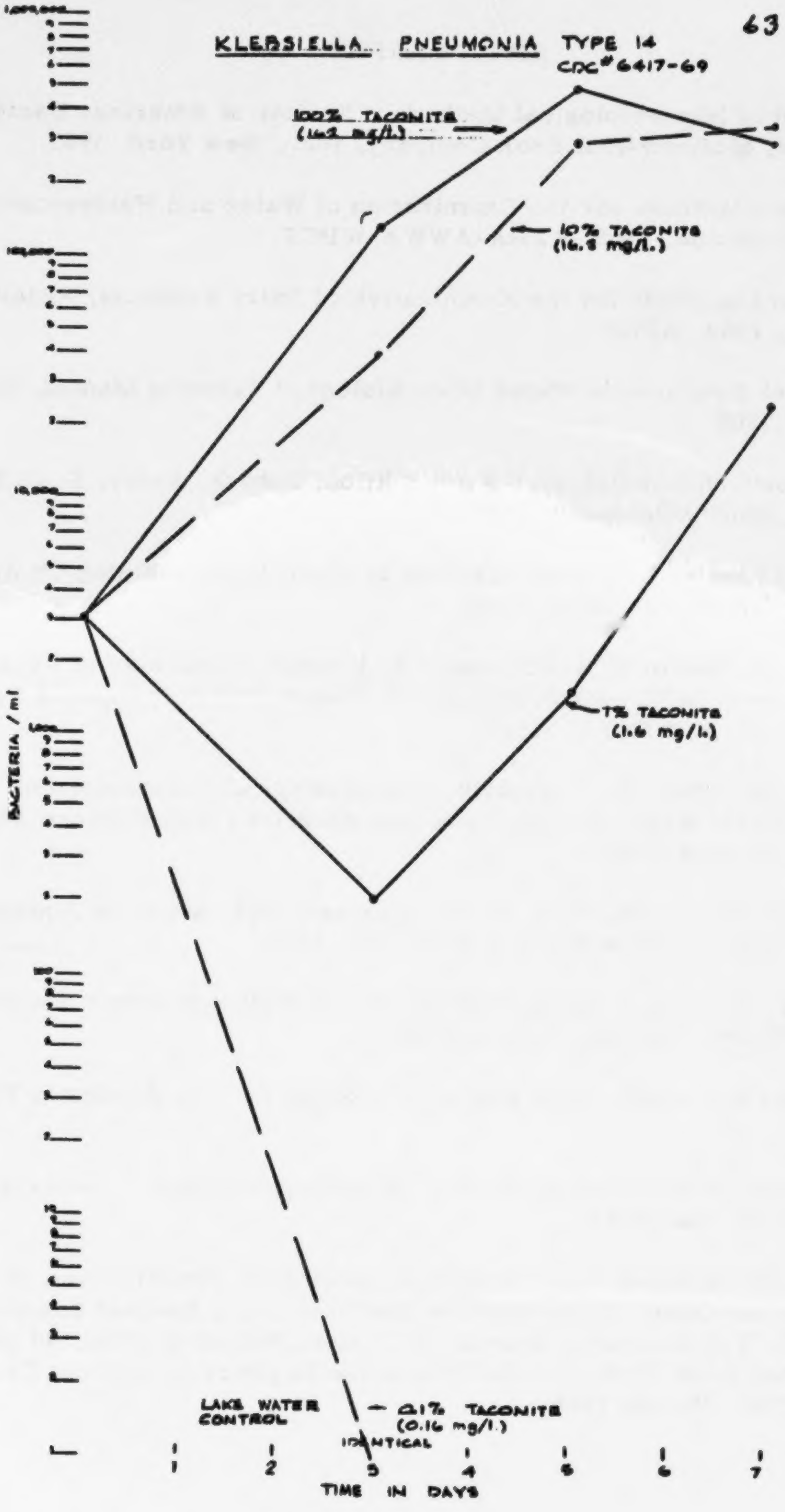

ESCHERICHIA COLI NWQL #294
1,000,000
100,000
10,000
1,000
100
10
1
2
3
4
5
6
7
8
9
BACTERIA / mL
100% (162 mg/l)
1% (1.6 mg/l)
10% (16.2 mg/l)
0.1% (.16 mg/l)
LAKE WATER CONTROL
1
2
3
4
5
6
7
8
9
10
11
TIME IN DAYS

FIGURE 2. *Klebsiella pneumonia,* type 14, CDC #6417-69. Response, in Organisms/ml, to Taconite Effluent (<2 µ particles) at 20° C


KLEBSIELLA PNEUMONIA TYPE 14
CDC# 6417-69
100% TACONITE (142 mg/l.)
10% TACONITE (16.3 mg/l.)
1% TACONITE (1.6 mg/l.)
LAKE WATER CONTROL
0.1% TACONITE (0.16 mg/l.)
IDENTICAL
BACTERIA / ml
1,000,000
100,000
10,000
1,000
100
10
1
TIME IN DAYS
1
2
3
4
5
6
7

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TACONITE BIOASSAYS

Armond E. Lemke

Introduction.

The question has been raised as to whether tailings are directly toxic to lake organisms. The bioassays described below were performed to determine the approximate tailings concentration that exhibits a toxic effect. Since only the finer particles are transported substantial distances by lake currents,. tests were made using the <2 μ particle size fraction suspended in the effluent water. Lesser concentrations were obtained by mixing an appropriate amount of effluent with raw Lake Superior water.

Methods.

Selective sampling throughout the Reserve plant revealed that the hydroseparator effluent had the largest amount of 2 micron and less particles and fewer large particles. This point was used as a source of tailings for the bioassays and the hydroseparator in the number 4B area in the plant was used as a sampling point. Weekly samples were collected during most of the period, and a composite of material was also made by continuously pumping a small flow.

The samples for use in the bioassays were siphoned from the hydroseparator into 5-gallon polyethylene jugs; about 60 gallons of hydroseparator effluent was collected weekly. The material was placed in a 20° C constant temperature room and settled for 24 hours. The upper 30 centimeters of the liquid suspension, about 4 gallons of each 5, was then removed by siphoning. The liquid removed contained particles 2 microns and less as indicated by a settling table prepared by the Geological Survey. The remaining one gallon in each jug was composited and settled for an additional 24 hours after which the upper 30 centimeters was again removed by siphoning. The five original aliquots and the resiphoned one were composited, resulting in a mean solids concentration of approximately 200 mg/l. Weekly samples varied between 140 and 280 mg/l with a mean of 180.

Concentrations of 200, 20, 2, and .2 mg/l solids were used initially and in later tests concentrations of 200, 100, 50, and 25 mg/l were used to more precisely determine the toxic concentration level.

A modified proportional diluter was used to continuously deliver the various concentrations at a flow rate of approximately 17 ml/min. The tests were run in a constant temperature room, controlled at 8° C for the tests with Limnocalanus, a lake copepod; lake herring; brook trout; lake trout; and Mysis, a lake opossum shrimp. The tests with Daphnia magna were made at 20° C; the choice was based on the preferred temperature of the organism.

The pH determinations were made weekly as well as after filling the toxicant holding chamber in order to check uniformity of effluent samples. The pH of the 200 mg/l concentration varied from a low of

7.95 to a high of 8.25. The high pH occurred approximately two hours after addition of the new batch of material and the pH declined to the low just previous to adding new effluent. The pH decreased probably as a result of constant stirring and aeration. The control pH varied from 7.67 to 7.82; the high usually occurred in the afternoon, apparently as a result of photosynthesis in the lake. Dissolved oxygen concentrations were 90% or more of saturation in all cases.

Daphnia tests were begun with day-old animals, herring and brook trout tests were begun with freshly stripped and fertilized eggs. Limnocalanus and Mysis, adults or sub-adults, collected by plankton net from Lake Superior, were used. Lake trout eggs were well developed and in the eyed stage. Single groups of ten Limnocalanus per concentration, single groups of 20 brook trout eggs per concentration were used, and for all other species duplicate groups of 10 animals, or 20 per concentration, were used.

Results and Discussion.

In Table 1, the results expressed in mean survival percentages, are given for each test. The righthand column shows the length of time that the test was conducted; the length was, in part, determined by incubation time or generation time. Since only the Daphnia have been used in previous tests, the problems of testing new and delicate animals resulted in lower control survival and reduced precision. Considering the data as a whole, the 100% (200 mg/l) seems to have a consistent adverse effect on all species and Mysis and Limnocalanus appear to be sensitive at lesser concentrations, perhaps as low at 25% (50 mg/l).

Daphnia, one of the more sensitive organisms to heavy metals, appears to be little affected by tailings. Its reproduction was not significantly affected except possibly in the 100% (200 mg/l) concentration. Mortality could not be determined during the exposure because the animals were not visible in the turbid water but it is probable that some adults may have died of natural causes during the three-week test giving variable numbers of surviving adults.

Lake trout eggs were not available in the earlier developmental stages--the stage that is usually more susceptible. The effects on both of the important lake invertebrates, Mysis and Limnocalanus, are consistently related to concentration and therefore are probably true effects even though control survival is less than the usually accepted 80% value.

The low control survival for most organisms suggests that either test conditions and/or test animals were not optimum. If anything, the effects of taconite on the test animals should have been greater due to stress from test conditions or inferior animals and therefore the effects would appear abnormally severe. (The avoidance of tailings by fish has not been measured.)

Conclusion.

Direct toxic effects of tailings on the lake organisms were found at concentrations that would be expected to occur only in local areas of the Lake.

TABLE 1

Percent Survival of Selected Organisms Exposed to Various Concentrations of Tailings

Concentrations tested mg/l solids

Species	200(1)	100	50	25	20	2	0.2	Control	Test Duration
Daphnia magna	20				60	25	50	50	21 days
D. magna	35	65	75	35	50			50	21 days
Young(2) produced	11	127	50	183				95	
Limnocalanus	0	0	0	10				60	21 days
Lake herring(3)	15				15	15	30	30	128 days
Brook trout (4)	25				60	80	85	55	118 days
Lake trout (5)	40				85	80	50	75	43 days
Mysis (6) relicta	0	0	20	50				50	21 days

[1] 200 mg/l = 100% effluent less >2 μ particles
[2] Values are absolute numbers
[3] began with stripped eggs
[4] Began with stripped eggs
[5] Began with late-eyed eggs
[6] Used adults collected from Lake.

Effect of Taconite Tailings on Algal Growth

by

R. W. Andrew and G. E. Glass

Investigations by the Staff of the
National Water Quality Laboratory
April 1970

Introduction

Concern regarding the disposal of taconite tailings in Lake Superior has arisen over possible biological effects on the Lake of soluble nutrients contained in the tailings effluent. Concurrent studies(8) by the National Water Quality Laboratory staff on the solubility of the tailings indicate that several elements (notably silicon, magnesium, sodium, potassium, and manganese) are soluble at concentrations considerably higher than the levels found in the water of the western basin of the Lake. All of the above elements are known nutrients required for algal growth(1,2), and could contribute to eutrophic effects if increased in concentration in the Lake as a result of such disposal practices.

Silicon is important because it is required in relatively large quantities for the formation of diatom spicules and is a major constituent of the tailings effluent. Recent work in Lake Michigan(3), for example, has shown that enrichment by as little as 0.7 mg SiO_2/1 resulted in increased cell counts, CO_2 utilization, and species diversity - particularly of the diatoms. Also, increases in the cell counts were well correlated with decreases in soluble silica concentrations.

The experiment described in this report was designed to indicate whether taconite tailings stimulate algal growth under conditions similar to those existing in Lake Superior.

Methods

The algal growth experiment was conducted using effluent with the >2 micron particles removed, diluted with raw, and filtered Lake Superior water. The <2μ suspension (and included dissolved solids) were separated by sedimentation(4) from a sample of "hydro separator" tailings collected at the Reserve Mining Company plant on 19 March 1970. Lake Superior water for the experiment was collected at the City of Duluth water intake on 23 March 1970. The suspended solids content and chemical analysis(8) of the tailings suspension and Lake Superior water are shown in Table 1.

Algae and diatoms contained in the raw lake water served as the initial inoculum for the growth experiment. Initial algal counts of the lake water contained 160 to 200 cells/ml, 90% were diatoms. To preclude variations attributable to algal cells in the taconite suspension, the suspension was heated for 1/2 hour at 60° C to kill the algae present. Terminal measurements of this suspension showed that no viable cells were present; nor was there any measurable chlorophyll.

The growth experiment was conducted at 10° C (±2°) under 22 hour/day illumination using a combination of Gro-Lux and Duro-Test* fluorescent lights. Raising the water temperature from the existing lake temperature (4° C) to approximately 10° C was intended to have the same stimulatory effect as summer temperatures under actual lake conditions, but without causing communities of atypical or temperature-tolerant species to develop. Likewise, increasing the photoperiod to 22 hours permitted increased growth at natural rates.

Dilutions containing 10%, 1%, and 0.1% tailings suspensions were prepared using a constant amount of raw lake water. All dilutions were made to a total of 1.2 liters using 0.22µ membrane filtered lake water. All solutions were tested in duplicate, in silanized(5) 2 liter flasks. Controls (in duplicate) containing 100% raw lake water, 90% raw lake water - 10% filtered lake water,

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* Mention of commercial products does not constitute endorsement by the Federal Water Quality Administration.

10% tailings - 90% filtered lake water, and 100% filtered lake water, were also carried thru the growth experiment.

The progress of the experiment was followed by removing subsamples periodically for algal counts and chlorophyll analyses. Positions of the flasks were randomized after each sampling. Algal cell counts of all flasks were made initially, after 9 and 11 days, and at the termination of the experiment (18 days) using Sedgewick-Rafter counting cells and standard microscope counting techniques(6). Chlorophyll analyses were performed using both colorimetric and fluorescence techniques(7) initially and after 10 and 18 days respectively. The experiment was terminated on 10 April 1970 after 18 days of growth. Additional chemical(8) and suspended solids analyses were performed at the termination of the experiment.

Results and Discussion

Algal cell counting and chlorophyll analysis of selected flasks showed that little or no growth occurred prior to the 5th day of the experiment. From the 5th day thru the termination at 18 days, all flasks except the sterilized and filtered lake water controls showed an increased rate of growth.

Algal cell counts determined after 9, 11, and 18 days are shown in

Table 2. Chlorophyll-a contents of the flasks after 10 and 18 days are shown in Table 3. The results at 18 days are shown on Figure 1.

These results reveal that the growth rate of algae in 10% tailings, is roughly 40-80% higher than in the control. Total cell counts and chlorophyll contents in the 10% tailings at the end of the growth period were statisticallly different from controls, at 90% and 99% confidence levels respectively. Intermediate growth rates were shown by the two lower tailings concentrations. The results indicate that the tailings effluent can be utilized by algae as a source of nutrients. Since the increase in growth rate is not in direct proportion to the tailings concentration, a growth response is indicated that is proportional to an increase in concentration of some essential element already present in the lake water. Calculations based on the data in Table 1, for example, indicate that the soluble silica concentrations to be expected in the various dilutions of tailings as prepared were: 3.340, 3.016, 2.984, and 2.980 mg/l for the 10%, 1%, 0.1% tailings, and controls respectively. In view of the algal responses to increases in silica concentrations noted(3) in Lake Michigan, this factor alone could explain the increased growth rate shown in Tables 2 and 3.

This is further supported by the chemical analyses performed at the termination of the experiment. A summary of these results is shown in Table 4. Comparing the soluble silica concentrations obtained for the various dilutions, a net decrease is noted in the soluble silica from that calculated above, except in the sterile 10% tailings control. A net increase is shown in this case, from the solution of the tailings particles during the 18 days of the experiment. (See Glass(8) for silica solubility rates from tailings).

Other differences in Table 4 do not appear significant, except possibly the soluble manganese concentrations. The manganese concentrations in all flasks show a net increase over that predicted from the original analyses. Suspended solids increases in the controls and 1% tailings are believed attributable to the increased biomass formed as a result of algal growth. The suspended solids content, however, of the 10% tailings dilution is less than the nominal 16.3 mg/l expected on the basis of dilution of the original suspension. This may be due to sampling error, since some flocculation and attachment of particulate matter to the sides of the flasks were observed.

Conclusions

1. Algal growth rate was higher in 10% (16 mg/l particles <2μ) taconite tailings suspensions.

2. Increased growth rates are related to increases in soluble silica from the tailings and possibly subsequent utilization by diatoms.

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Table 1 - Suspended Solids and Chemical Analysis of <2μ Tailings Suspension and Raw Lake Water Used in Algal Growth Experiment.

	Tailings Suspension (3/19/70)	Raw Lake Water (3/23/70)
Suspended Solids (mg/l)	163	0.64
Dissolved Solids*		
SiO_2 (mg/l)	6.58	2.98
Ca (mg/l)	12.9	15.4
Mg (mg/l)	4.58	3.49
Na (mg/l)	1.94	1.35
K (mg/l)	1.90	0.64
Mn (μg/l)	22.7	0.3
Zn (μg/l)	1.0	2.9
Cu (μg/l)	0.7	1.1
Total Hardness (mg/l as $CaCO_3$)	48.8	52.8
Total Alkalinity (mg/l as $CaCO_3$)	50.8	52.0

* Determined after passing a 0.22μ pore size membrane filter.

Table 2 - Algal cell counts in various concentrations of effluent containing <2μ particles and incubated at 10°±2° C.

Concentration	Time (Days)		
	9	11	18
10% tailings	1480±140**	2610±150	4680±760***
1% tailings	1450±200	2270±300	4180±290
0.1% tailings	1420±70	1850±110	3580±180
Control	1060±200	1590±420	3370±990
10% tailings 90% filtered lake water	<25	<25	<25

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* Counts expressed as cells per ml.

** Plus or minus values indicate total counting error.

*** Significantly different from controls at 90% confidence level. F Ratio equals 4.37.

Table 3 - Chlorophyll-a production in various concentrations of effluent containing <2μ particles and incubated at 10°±2° C.

	Time (Days)		
Concentration	0	10	18
10% tailings		0.89(2)*	2.92(4)***
1% tailings	0.74±.05 (4)**	0.78(1)	1.80(4)
0.1% tailings		0.67(1)	1.73(2)
Control		0.50(1)	1.57(4)
10% tailings 90% filtered lake water	-	-	0.00(2)

* Values expressed in μg/l

** Numbers in parentheses indicate number of chlorophyll analyses included in mean value.

*** Significantly different from controls at 99% confidence level. F Ratio equals 13.7.

Table 4 - Suspended solids and chemical analysis, of the various concentrations of effluent containing <2µ particles, at termination of the algal growth experiment.

Effluent Concentration	Suspended Solids (mg/l)	Dissolved Solids							
		SiO_2 (mg/l)	Ca (mg/l)	Mg (mg/l)	Na (mg/l)	K (mg/l)	Mn (µg/l)	Zn (µg/l	Cu (µg/l)
10% tailings	14.0	3.02	13.5	3.50	1.51	0.82	7.4	2.7	1.4
1% tailings	3.7	2.18	12.9	3.24	1.36	0.62	1.5	4.2	1.4
0.1% tailings				- No analyses -					
Control	3.5	2.30	13.8	3.36	1.40	0.63	0.9	5.5	1.7
10% tailings 90% filtered lake water	18.2	4.33	12.6	3.40	1.43	0.79	8.9	2.1	1.1

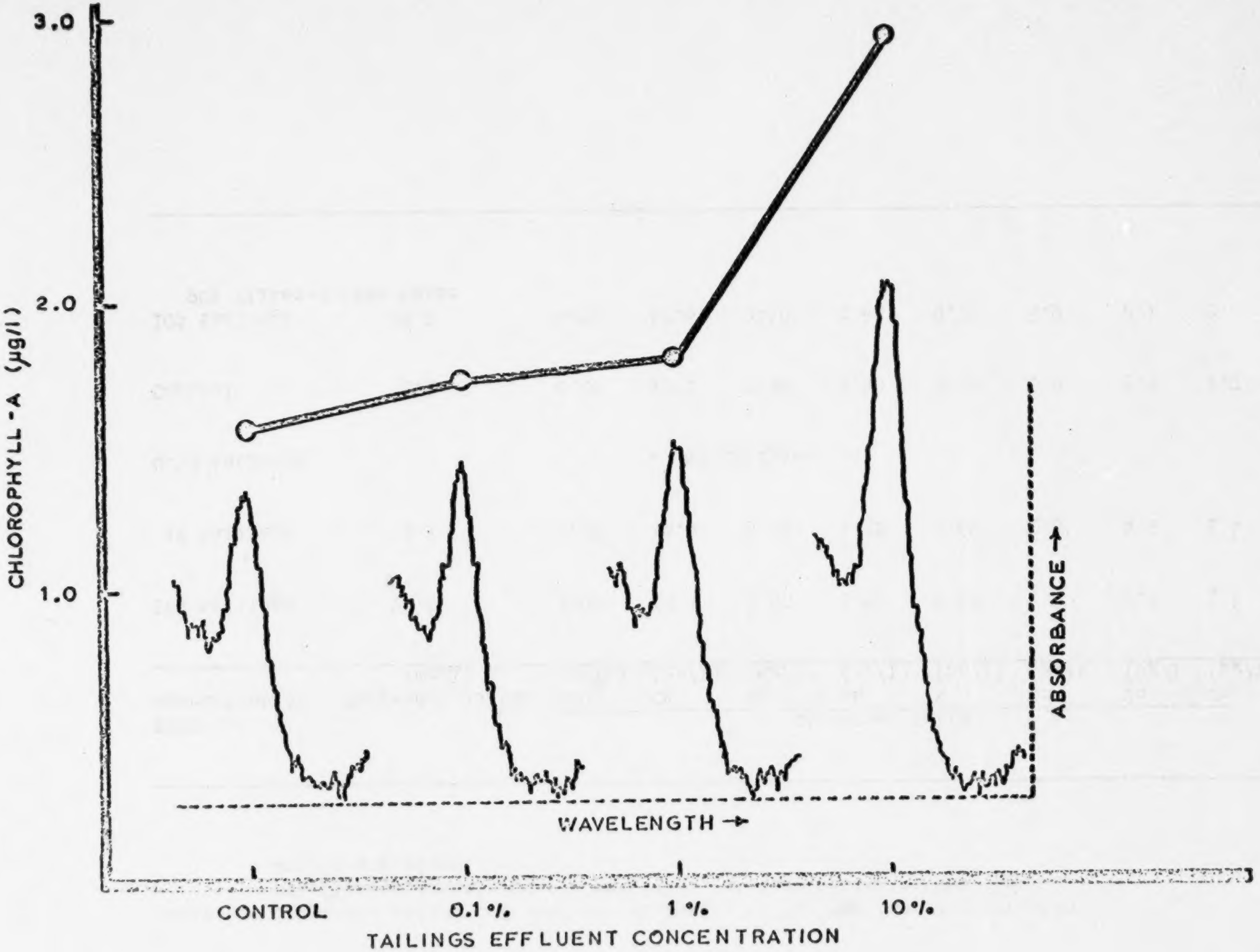

Figure 1. Chlorophyll-a content and spectra (6630 Å region) versus taconite tailings effluent concentration.

The Dissolution of
Taconite Tailings in
Lake Superior

by

Gary E. Glass, Ph.D.

Contribution from the
National Water Quality Laboratory
Federal Water Quality Administration
Department of the Interior 1970

Introduction

The Conferences on pollution of Lake Superior and its tributary basin held in Duluth, Minnesota May and September 1969 called attention to the mining practices of Reserve Mining Company, Silver Bay, Minnesota. The process used for extracting iron involves crushing the minerals in a water slurry and removing the magnetite using electromagnets. The extracted slurry (taconite tailings) is then pumped into Lake Superior. Particle sizes of minerals in these tailings are extremely small with 40% of the total tailings less than 44 microns (0.0017 inches) and ∿3% less than 2 microns (0.00008 inches). As a result of these conferences, the questions of taconite solubility, distribution and effects on Lake Superior have been posed. This study was designed to provide answers to the first of these questions.

The minerals which make up taconite tailings are comprised mainly of silicates; quartz (SiO_2), cummingtonite ($Mg_4\ Fe_{2.5}\ Mn_{0.2}\ Ca_{0.4}\ Si_{7.9}\ Al_{0.1}\ O_{22}\ (OH_2)$, grunerite, ($Fe_{4.7}\ Mg_{2.1}\ Mn_{0.2}\ (Si+Al)_8\ O_{22}\ (OH_2)$), magnetite, ($Fe_3O_4$) and small amounts of others. The extremely small particle size to which these minerals are crushed exposes tremendous surface area to chemical activity. Marked increases in the rate of solubility of quartz with increasing surface area have been measured(1). Quartz was found to dissolve to the extent of 11 mg/l soluble silica (SiO_2) at equilibrium, 25° C. The dissolved silica concentration in Lake Superior is ∿ 2.6 mg/l.

In general, the rate at which inorganic salts dissolve is a diffusion controlled process(2), that is, the rate determining step is the speed at which the dissolved species leaves the particle site. Stirred solutions will dissolve more rapidly and approach chemical equilibrium faster than unstirred solutions. Temperature has a marked effect on the rate and extent of dissolution. Amorphous silica requires more than 80 days to reach chemical equilibrium at 25° C(3). The equilibrium concentrations of soluble silica vary with temperature and are 70 mg/l at 0° C, 120 mg/l at 25° C, and 350 mg/l at 90° C(3). Solubility and thermodynamic data have been determined for several clay minerals(4) where chemical equilibrium required 2-5 years to be attained at room temperature.

Little is known about the weathering properties of cummingtonite, the main component of taconite tailings. This mineral is formed at high temperatures(5) and in an aqueous environment is probably unstable or metastable at best. Preliminary solubility tests by Reserve Mining Company(6) show increases in dissolved Ca, Mg, Mn, Fe, and SiO_2. These tests were conducted over a 4-month period at 4° C. The particle size of the sample was not known and the amount of sample used in the test was too small (6 gms/2 gallons). These conditions are not sufficient to assess the solubility of tailings in view of the factors given above. For the studies of natural sediments(4), two to ten grams/liter were used at 25° C, 2-5μ in size, with minimal shaking to come to equilibrium in a year's time.

The main elemental components of taconite tailings will be followed by chemical analysis. These are SiO_2, Na, K, Ca, Mg, Fe, Mn, and Al. The latter three are thermodynamically unstable at lake conditions and should precipitate.

Methods

Metal analyses were performed using an atomic absorption spectrometer equipped with a direct digital readout (Perkin-Elmer Model 403)*and three-slot Boling type burner. Aqueous solutions of sodium, potassium, and silica (7) were aspirated directly as were calcium and magnesium solutions after dilution with a lanthanum chloride solution. Copper (8), iron (8), manganese (9), cadmium (9), and zinc (9) were concentrated by chelation and extraction with methylisobutylketone. Freshly-prepared standards (Hartman-Leddon Company) were used for instrument calibration.

Optical absorbance measurements were made using a ratio recording spectrophotometer (Perkin-Elmer 402) with matched quartz cells. Dissolved oxygen (10) and silica (10, 11, 12) were measured colorimetrically.

All pH measurements were made with an expanded scale, temperature compensated instrument (Corning Model 12) and glass electrodes (Beckman Instruments). Conductance measurements were made with an impedance bridge at 1000 hz (Heathkit Model 2B) and dip type cell, K=0.1 (Yellow Springs Instruments Co., Inc., No. 3402) at constant temperature, 18 ± 0.1° C, in a circulating water bath (Forma Scientific, Inc. Model 2095).

Ultra-high purity water (18 megohms) was used throughout the experiments for analysis and dilutions (Millipore Corp., S-Q system using distilled water input). All chemical reagents were of A.C.S. reagent grade or better.

Samples were collected in aged polyethylene bottles which had been rinsed with acid, lake water, and distilled water, and stored in dark constant-temperature rooms at 6 ± 2° C and 20 ± 2° C for the different experiments.

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* Manufactures are mentioned for equipment identification purposes only.

Results and Discussion

The results of the taconite dissolution rate measurements are shown in Table 1 and Figures 1 and 2. The increased rate at which tailings dissolve at 20° C allows the chemical equilibrium of the system to be approached in a reasonable period of time and makes possible accurate measurement of dissolving substances. Elements which dissolve and are not at chemical equilibrium will react faster at higher temperatures forming insoluble compounds and will not show significant solubilities. The experiment was started by adding fresh taconite tailings from a hydroseparator to premeasured volumes of distilled water in one liter plastic bottles. The bottles were stored at 20 ± 2° C except during conductance measurements when they were placed in a constant-temperature bath at 18° C. The increase in conductance which occurs after the initial increase when the ore is processed, shows further dissolution of the tailings after they leave the plant (Figure 1). The rate at which tailings dissolve during the first few days is much greater than the long-term rate of dissolution as is indicated by the large initial slope of the conductance-time plots. Significant increases in soluble silica, potassium, calcium, magnesium, and dissolved solids* were measured. Sodium, iron, copper, manganese, zinc, and cadmium showed little or no increase in concentration within experimental error for the 0.1μ membrane filtered samples. The net rates of dissolution, Table 1, increase with decreasing concentration of tailings and dissolved solids.

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* Increases in dissolved solids were estimated using differences in specific conductivity (13). The relationship was derived at 25° C and may be used at other temperatures to determine differences between solutions with little increased error.

This is probably due to increased clumping of particles in the higher concentrations resulting in less exposed surface area/gram of tailings. The initial concentration of dissolved solids decreases with decreasing concentration (due to dilution with distilled water) making the approach to chemical equilibrium faster at the lower concentrations.

At lower temperatures the rate of dissolution and the approach to chemical equilibrium is slower. In a second experiment, fresh tailings from a hydroseparator were held at 6° C, and one liter samples were taken periodically after shaking. The results of analysis of these samples are shown in Figure 2. Silica, manganese, potassium, and magnesium show measurable increases during a 4-week period. Little or no further increase was observed for zinc (1.3 μg/l), cadmium (<0.1 μg/l), copper 0.7 (μg/l), iron (1.4 g/l), calcium (12.5 mg/l) and sodium (1.9 mg/l) over the 28 day period. Compared to the 20° C data, the only differences are calcium and manganese. No increase in the concentration of calcium was measured within experimental error over the 4-week period at 4° C. The manganese (II) ion reaction with dissolved oxygen produces insoluble manganese IV oxide. In general, reaction rates increase with temperature and at 20° C over a 90-day period manganese-dissolved oxygen chemical equilibrium may be reached, precipitating the initially soluble manganese as manganese dioxide.

In order to estimate the total quantity of taconite tailings which dissolves under lake conditions (low temperature, high dissolved oxygen and minimal stirring) a series of five-gallon samples were taken in the plant from a main launder chute over a two-week period. The samples were kept at 6 ± 2° C in the dark in a constant temperature room with no stirring or shaking. Three of the samples were chemically analyzed in detail after 332 days and the data are shown in Table 2. The supernatant water above the tailings in each bottle was carefully siphoned off and the remaining water and approximately 6 mm of settled tailings were thoroughly mixed and transferred to centrifuge bottles for separation. Both the supernate and the centrifuge decantate were then filtered (0.1 μ membrane) for chemical analysis. X-ray diffraction analysis of the suspended solids showed mainly cummingtonite and quartz. The relative percentage of quartz increased when the suspended solids were filtered with a 0.1 μ pore size membrane versus a 0.45 μ membrance. An average of 20% of the remaining suspended solids in the supernate passed through a 0.45 μ pore size membrane filter.

The volume of interstitial water was determined for the centrifuge packed solids and is assumed to approximate the gravity sedimented values. The differences in the chemical analysis between the top and bottom water fractions are due to the increased concentrations of solubles in the interstitial water. Using the appropriate volume corrections, the concentrations of dissolved salts in the interstitial water may be estimated. They are: Si (37±3 mg/l), Na, (4.4±1 mg/l), K (13±4 mg/l), Ca (53±3 mg/l), Mg (10±3 mg/l). These are maximum values only and their accuracy is limited by large inherent errors in the calculation. They are included only as an indication that further dissolution does take place in the interstitial water of the tailings following sedimentation on the lake bottom.

In order to assess the total input of dissolved salts to Lake Superior water, the total or gross increase of each dissolved substance in the supernatant water was measured and compared to the total weight of taconite tailings sedimented. The gross increases per kilogram of total taconite tailings added to Lake Superior (Table 2) should be considered as "ball park" estimates. Some of the uncontrolled factors which would increase these values are dilution in the Lake causing increased rates of dissolution, the presence of organic and inorganic complexors, stirring due to Lake currents and sedimentation,and clumping in the bottles of the "fines" with the course particles to a greater extent than is found in the "heavy density current." Factors which would decrease these values are the presence of organic and inorganic reactants which would coagulate the particles and precipitate the soluble salts, and immediate covering of the tailings surface in areas with high natural sedimentation rates.

The above factors may tend to cancel each other making the calculated gross increase, a reasonable estimate. But due to the variability within ore deposits, more accurate values would be obtained by sampling over a larger span of time.

Conclusion

1. In addition to the increase in soluble salts as the ore is processed, taconite tailings show continued solution after leaving the plant.

2. The rates of dissolution increase with decreasing concentrations of particles/unit volume of water and with increasing temperature.

3. After 332 days, increases in soluble components from tailings in Lake Superior water under simulated lake conditions were:

Component	Increase in mg/kg total tailings
SiO_2	331
Na	37
K	70
Ca	282
Mg	11
SS	61
TDS	1110

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Table 1 - Summary of Taconite Dissolution Rate Study (20° C, 90 days)

Solution Composition[a]	Total Suspended Solids	<2µ Suspended Solids	pH		Specific Conductance 18°C	
% Tailings Effluent	mg/ml	mg/ml	initial	final	initial µ-mhos/cm	final
100%	19.8	1.1	8.60	7.71	97.7	124.
75%	13.7	0.81	8.61	7.57	75.7	106.
50%	9.02	0.55	8.72	7.61	57.3	86.2
25%	5.19	0.37	8.95	7.61	39.2	67.5
0%	0.00	0.00	4.8	5.2	0.87	1.76
Lake Superior Water[b]	0.00	0.00	7.72	7.43	85.9	85.4

[a] Hydroseparator tailings, dilution made with distilled water. Samples shaken each day for ten days and weekly thereafter.

[b] Source: Lakewood Pumping Station, Duluth, Minnesota.

Table 1 - Continued

Solution Composition	Concentration of Final Solutions Samples filtered, 0.1µ pore size										Net Rate of Increase (20°C, 90 Days)					
% Tailings Effluent	mg/l					µg/l					mg increase/kg tailings[d]					
	SiO_2	Na	K	Ca	Mg	Fe	Cu	Mn	Zn	Cd	SiO_2	Na	K	Ca	Mg	TDS[e]
100%	14.6	2.56	5.10	17.1	4.93	1.7	0.7	0.9	1.7	0.0[c]	430	0	100	210	70	795
75%	12.1	1.94	4.11	15.1	3.82	2.9	0.6	0.4	1.2	0.0	550	0	130	390	90	
50%	9.23	1.36	2.88	13.2	2.73	2.8	0.7	0.4	10.0	0.0	690	8	140	750	110	
25%	6.35	0.76	1.76	11.3	1.58	4.9	0.5	0.4	3.6	0.0	940	120	190	1500	140	
0%	0.00	0.00	0.00	0.00	0.00	3.9	0.7	0.0	2.1	0.0	-	-	-	-	-	
Lake Superior Water	2.62	1.15	0.55	14.2	3.00	2.5	1.5	0.0	0.9	0.0	-	-	-	-	-	

[c] Less than 0.1 µg/l.

[d] Calculated using initial concentration of 100% tailings immediately after processing: SiO_2 (6.0 mg/l), Na (2.58 mg/l), K (3.18 mg/l), Ca (13.0 mg/l), and Mg (3.53 mg/l).

[e] Total dissolved solids, calculated using 0.605 mg/l per µmho/cm change in conductivity (13).

Table 2.

Summary of Taconite Dissolution Study

(6° C, 332 days)

Sample	Date Collected Elapsed Time	Fraction of Sample		Solids: Suspended, Filter Pore Size 0.45µ	Solids: Suspended, Filter Pore Size 0.1µ	Solids: Sedimented Total	Solids: Sedimented <2µ	Packed Sedimented Solids: Density, Wet	Packed Sedimented Solids: % Water	Packed Sedimented Solids: Interstitial Water Volume	Dissolved Oxygen	pH	Specific Conductance 18° C
			liters	mg/l	mg/l	g	g	g/ml	%	ml	mg/l		µ-mhos/cm
I	3/25/69	Top	17.49	2.91	3.21	--	--	--	--	--	12.4	8.09	147
I	337 days	Bottom	2.03	--	--	806	28.8[c]	2.41	21	215	--	8.13	153
II	3/30/69	Top	17.44	1.76	2.22	--	--	--	--	--	12.9	8.07	148
II	332 days	Bottom	2.08	--	--	512	22.3[c]	2.26	22	148	--	8.07	154
III	4/4/69	Top	17.35	1.82	2.58	--	--	--	--	--	12.2	8.10	142
III	327 days	Bottom	2.17	--	--	623	17.7[d]	2.29	24	196	--	8.07	149

[a] Study terminated 2/25/70.

[b] Determined after centrifugation of sample.

[c] Determined by centrifugation.

[d] Determined by gravity sedimentation.

Table 2 - Continued

Sample	Final Concentrations of Lake Water Samples Filtered, 0.1μ Membrane										Total Increase per Kilogram of Total Taconite Tailings[f] (6°C, 332 days)						
	mg/liter					μg/liter					mg increase/kg tailings						
	SiO_2[e]	Na	K	Ca	Mg	Fe	Cu	Mn	Zn	Cd	SiO_2	Na	K	Ca	Mg	Suspended Solids	Dissolved Solids[g]
IT	12.9	2.69	4.38	21.0	6.97	0.0	0.0	1.4	0.5	0.0	244	37	90	185	94	62	874
IB	14.3	2.79	5.70	23.0	7.12	1.8	2.4	2.8	12.8	0.0	--	--	--	--	--	--	--
IIT	13.3	2.08	2.31	24.1	6.14	0.3	0.0	2.4	0.4	0.0	402	36	65	409	118	61	1410
IIB	15.3	2.19	2.98	26.3	6.25	0.3	0.2	0.7	0.6	0.0	--	--	--	--	--	--	--
IIIT	13.9	2.36	2.34	21.4	6.88	1.7	0.1	1.2	0.5	0.0	347	38	54	252	120	61	1040
IIIB	16.4	2.51	3.20	24.6	7.10	0.0	0.1	0.5	0.4	0.0	--	--	--	--	--	--	--
										Averages	331	37	70	282	111	61	1110

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[e] Mean value for tops of entire series, 13.2 ± 1.0 mg/1.

[f] Calculated from increased values in water over tailings compared with "open" Lake Superior water values: Si (2.6 mg/1), Na (1.12 mg/1), K (0.57 mg/1), Ca (13.2 mg/1), Mg (2.99 mg/1), suspended solids (0.6 mg/1), and specific conductance (86 μ-mhos/cm, 18° C).

[g] See footnote 'e' Table 1.

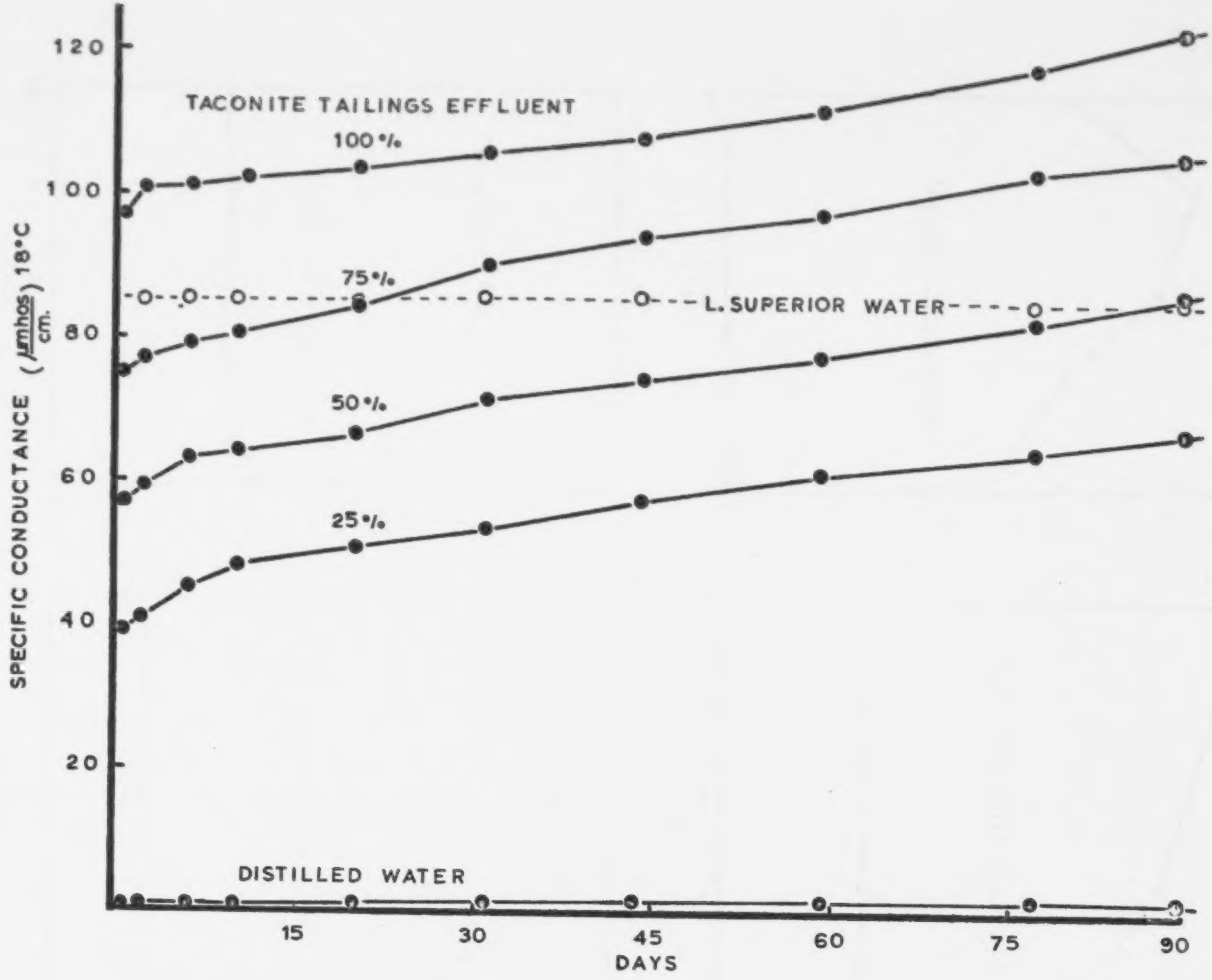
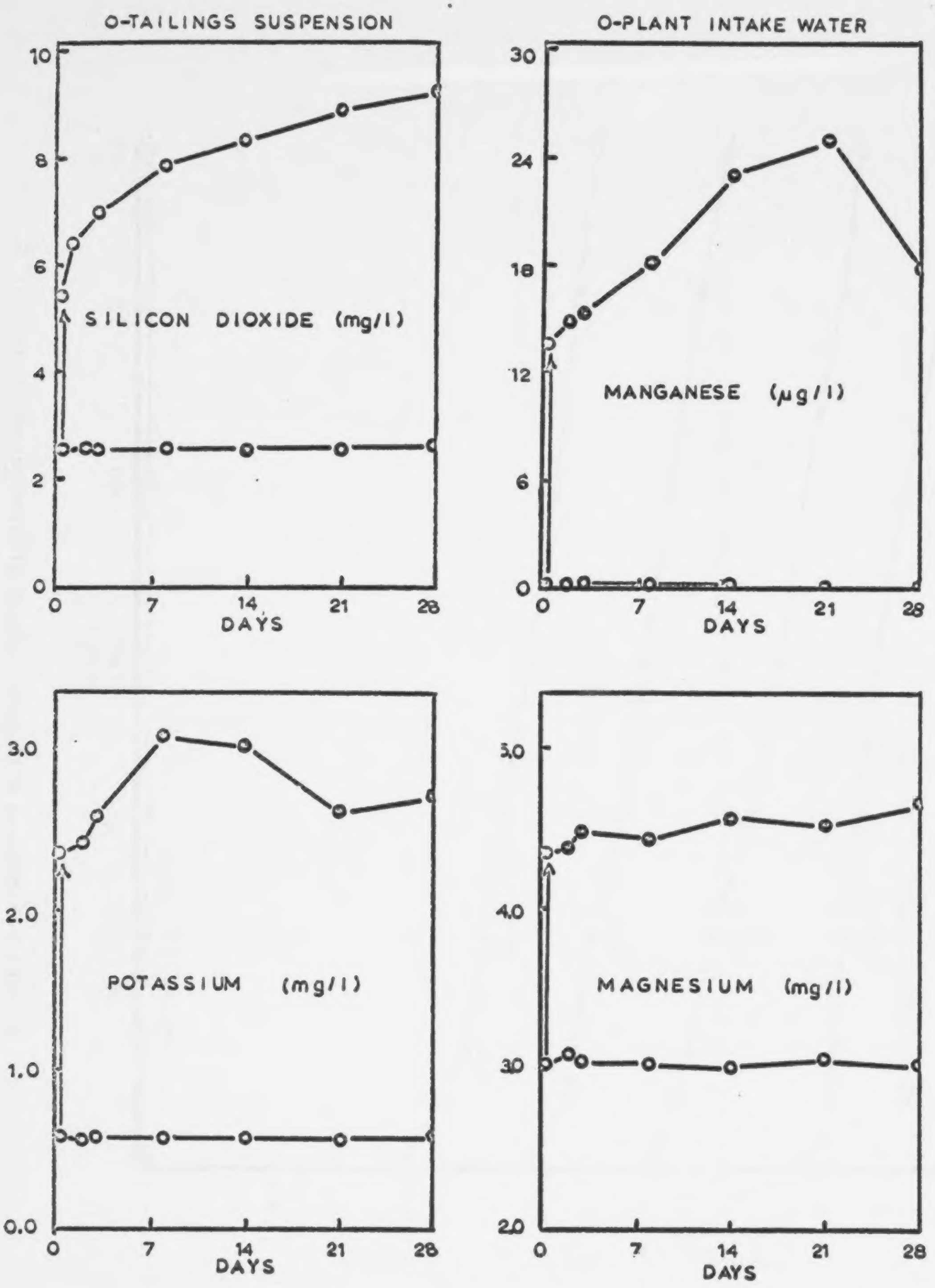


FIG. 1. Specific conductance of taconite tailings effluent versus days at 20° C.

Figure 2. Chemical analyses of taconite tailings effluent *versus* days at 6° C.



DR. MOUNT: I would also like to indicate that the slides which I will use in a few minutes need not be entered into the record so far as we are concerned because they are contained in the figures or they are identical to the figures appended to my statement.

The statement which I am going to give has been very carefully worked over by myself and our staff in order to try to present what we believe are the key points that have been raised in past conferences, what the data really show and particularly the results of the additional studies which we were instructed to do by the Commissioner of FWPCA.

During the past sessions of this enforcement conference, statements have been made regarding the effects on the ecology of Lake Superior of taconite tailings discharged from Reserve Mining Company. The purpose of my presentation today is to attempt to identify important points which the National Water Quality Laboratory feels have been established beyond reasonable doubt. We have been conducting laboratory investigations regarding the chemical and biological behavior of tailings and we completed a sampling survey of Lake Superior bottom sediments last summer. Results of these studies are presented in technical reports that have been sent to each of the conferees in advance of this conference.

During the autumn of 1968, members of my staff studied in some detail the characteristics of green water that occurs along the Minnesota shore and is particularly noticeable in autumn and spring. The purpose was to identify the characteristics of green water and the source, if possible. As a result of these field and laboratory investigations,we found that green water contains approximately 1.5 parts per million of suspnded solids as opposed to clear water which contained .5 or less parts per million of suspended solids. Attendant with this increase of suspended solids concentration is a reduction in light penetration by as much as 5 to 10 times. Divers report that when viewed at night using a flashlight beam, particles can be observed in a sunbeam--excuse me--particles can be observed as a sunbeam passing through dusty air. On some days, bands of green water extended in a continuous fashion from the Reserve discharge to many miles southwest on the plant, and there was no doubt in the minds of the divers observing the green water bands that the source was Reserve Mining.

To provide objective data substantiating this observation, detailed analyses of the suspended solids were completed to identify the same, using the presence of cummingtonite and the absence of clay minerals as indicators. The results established beyond reasonable doubt that these bands of green water were due to tailings suspended in the water.

Figure 1, slide 1, shows the characteristic x-ray diffraction patterns of the suspended solids in green water and of effluent from the plant. Normal clay minerals are absent and the patterns are identical for both samples, suggesting a common source. These are being pointed out now on the screen.

Figure 2 shows characteristic x-ray diffraction patterns for sediments from two tributaries to Lake Superior. Note the absence of cummingtonite and the presence of normally found clay minerals. Other laboratory studies of the reflectance spectra of suspended tailings from green water indicated that the color would appear as yellow-green to the eye.

If we could have the lights, please.

Green water masses sampled along the Wisconsin shore, and caused by heavy rainfall and subsequent run-off, contained only a trace of cummingtonite but the normal clay minerals that are found in natural sediments were present. Since these analyses did not reveal the presence of tailings in green water masses along the Wisconsin shore, the results added confidence that the method of identifying tailings in Lake Superior water by the use of cummingtonite is a valid one.

Other data were presented in the May session of this enforcement conference and established the presence of cummingtonite in the water supplies of several municipalities along the Minnesota shore. The significance of these findings is not that there is an adverse effect on water supplies, but that the percent of tailings in the sediment of the water supplies decreased with distance from the Reserve plant, indicative that the source was from that discharge. Furthermore, sediment collected from the detention basin at the

Duluth Lakewood Pumping Station in 1962 was negative for cummingtonite and therefore not containing tailings, but sediments obtained in 1969 were positive for tailings. These observations lend strong evidence that the source of the tailings could not have been from the insignificant use of them on the highway for ice control and highway fill.

Some were not convinced that the method was valid, so a core sampling program was developed to establish whether or not there were natural sources of commingtonite in other parts of the lake that might confuse identification of tailings. Undisturbed core samples were taken with conventional core sampling devices, quick frozen aboard the vessel, and brought to the laboratory for analysis. Sections of these cores were made and the measurements of cummingtonite, and therefore tailings, were quantitative. The detailed results and statistical evaluations are presented in the technical report supplied to you.

Traces of cummingtonite in tributaries had been found and reported previously in the May conference, so it was necessary to quantify the amount present and contributed from natural sources. The bottom portions of the cores had the same percent cummingtonite as the natural stream sediments from tributaries in Wisconsin and Minnesota. This established that the input of trace amounts of cummingtonite from tributaries was not changed for a long period of time and that our estimates of these trace amounts contained in stream sediment are representative.

Knowing the true amount of cummingtonite from natural sources enabled us to positively distinguish the input from Reserve even though very minor amounts are found in the stream sediment. The cummingtonite content of the upper layers of some cores is much higher, indicative of a more recent and new source of that mineral. Cores taken "down current" from the Reserve discharge and near the plant show as much as 30 percent cummingtonite or as much as 75 percent.

The statistical analysis performed revealed that 7 of 14 cores from the Wisconsin side of the lake contained tailings in the upper layers of the core. The percent of tailings in lake sediment is low and deposition is discontinuous over the area southwest of the

Apostle Islands. Tailings are mixed with the surface layers of sediment and are not as a blanket over the bottom. Slide 3 shows the relationship between the depth of tailings within the core--the depth of tailings plotted on the vertical axis and the amount of tailings on the horizontal. Those would be the bar graphs. Yes, the amount of tailings horizontally and the depth within the core on the vertical scale. And these are shown in relation to the depth of water in which the sample was taken for a transect from Encampment Island to Herbster, Wisconsin. One can see that the tailings are being deposited primarily in the edge or in the deep trough, as shown by the bar graphs with the wide parts at the top, off the Minnesota shore and that on this transect no tailings were found in the Wisconsin portion of the lake, indicative that the tailings are not crossing the lake at that point.

The next slide, Figure 4, shows a similar plot for a transect extending from Stony Point to Brule River. You note that the water depth is not as deep now; we are out of the deep part of the trough, and one can see that the tailings are deposited over a broad area of the lake and in Wisconsin. This pattern may be caused by lake currents carrying suspended tailings out of the trough into more shallow water, forcing them to spread. This suggests a reason Wisconsin samples on the Encampment Island-Herbster transect, which was the previous slide that I showed, were negative. The obvious stratification of cummingtonite in the core establishes beyond reasonable doubt that the source is a recent one.

If we could have the lights, please.

In conjunction with the other data, this clearly identifies the source of cummingtonite as tailings and demonstrates movement into a State other than that one in which the discharge originates.

Another investigation completed during the past winter at the National Water Quality Laboratory was one to measure the direct toxic effects of tailings on lake animals. For these tests, we utilized the liquid portion of the effluent and only the less than 2 micron tailings. This decision was made because we do not expect the coarser particles to be carried great distances in Lake Superior. The results of these tests also have been presented in a technical report also.

Dr. D. I. Mount

Concentrations less than 10 percent, which would be equivalent to 20 parts per million of suspended solids, less than 2 microns, had no direct effects on the eggs of brook trout, lake trout or lake herring, nor were there significant effects on the reproduction of important plankton organisms such as *Daphnia*. The data for *Mysis* and *Pontophoria*, two of the important invertebrate food organisms in the lake, are inconclusive, but suggestive that there may have been effects at lesser concentrations. Mortality in control tanks was higher than is normally acceptable for bioassays of this type, and so no significance can be attributed to these mortalities of these two invertebrates. Bioassay data clearly suggest that direct adverse effects of the tailings on fishes and fish food organisms will not occur at the concentrations expected in the lake, except for local areas near the discharge and in the heavy density current.

Other tests were performed utilizing Lake Superior plankton to determine whether or not there is algal growth potential from the effluent. The results of these growth tests utilizing Lake Superior algae, at prevailing summer surface temperatures, reveal that at 10 percent effluent (equivalent to 20 parts per million suspended solids) there were slight growth promotion effects of the effluent as shown in the next slide.

You can see that the amount of chlorophyll approximately doubled in the 10 percent concentration. The jiggly lines at the bottom are the tracings of the spectograph recording the chlorophyll analyses. These are not large, but do suggest that there is some nutrient value in the tailings and that a sufficient concentration produces a measurable increase in algal growth. These data do not suggest that there will be an algae bloom near the point of discharge, but indicate that materials are dissolving that provide nutrients for algal growth and that the tailings therefore should be considered as one source of nutrients in Lake Superior.

Still other tests were performed to determine the effect on the growth of bacteria of sanitary significance. E. coli, one of the most commonly used indicator bacteria, and Klebsiella pneumonia, a human pathogen, were used as representative bacteria for the tests. Figure 6, the next slide, shows the response of E. coli to tailings. The 0.1 percent effluent in Lake Superior water compared to 100 percent lake water caused a significant decrease in the dieaway of E. coli. This is to say that they lived longer and grew and did not die away as they did in the lake water. And the 1 percent concentration produced a luxurient growth of bacteria.

Figure 7 shows the response of Klebsiella to taconite tailings, and in this case there was no response at 0.1 percent but a significant response at 1 percent--the 1 percent equivalent to 2 milligrams per liter, a particle less than 2 microns. These tests suggest strongly that bacteria discharged into the lake will live longer or even grow in the presence of tailings. Most importantly, however, these tests demonstrate that the tailings are biologically active and they are not inert.

At the present time,known discharges of bacteria to Lake Superior are not numerous and the number should be reduced when adequate treatment is provided. There is no implication from this data that we should expect to see a bacterial problem in Lake Superior if discharges containing bacteria are adequately controlled.

Solubility studies were also made to establish the rate of solution of tailings in Lake Superior water. Some solubility studies were performed at summer temperatures in order to accelerate the rate of solution and to compress the experimental period into a shorter time span. The results of some of these studies are presented in Figure 8, the next slide. You can see a rapid increase in dissolved materials as the water passes through the plant, shown on the initial part of the curve as a vertical line, and a much slower rate of solution during the next 28 days. Various dissolved solids increased from 1-1/2 to 18 times over those in lake water.

Figure 9, the next slide, shows the increase in conductance of the water in contact with tailings. During a period of 90 days, conductance, an indicator of total dissolved solids, increased from 30 to 70 percent, depending on the suspended solids concentration.

If we could have the lights now, please.

Other tests measured solubility of total tailings effluent in 5-gallon carboys at 6° Centigrade for a period of 332 days. These provided a more realistic picture of the solubility rate that might be expected from tailings settled on the lake bottom. This experiment was unrealistic in that there were no water currents in the jugs to mix the dissolved materials. These data show increases up to 100 percent in the dissolved silica, sodium, potassium, calcium and magnesium, indicating that even in the absence of currents and when settled on the bottom, the tailings do dissolve slowly. Increases in dissolved solids in interstitial water were much larger.

Since Reserve reported preliminary data on bottom fauna studies in May, we did not conduct additional sampling surveys in the lake, but we look forward with great interest to hearing at this conference the results of those studies.

Unfortunately, it was not possible to conduct the experimental work designed to determine whether or not important fishes in the lake, such as lake herring, avoid green water. These studies would have been helpful in assessing the significance of green water along the Minnesota shore and in verifying the alleged effects on commercial fishing.

The data presented do not clearly reveal the impact of tailings on Lake Superior. I have had numerous discussions with my staff regarding the probable impact of tailings on the lake viewed in light of the data currently available. We are fully aware of the serious consequences of failing to adequately protect Lake Superior from man-made discharges and we are also keenly aware of the expensive disposal methods which would have to be employed in order to eliminate this discharge. With these important considerations in mind, and in light of the scientific data presently available, we believe that the following points are established beyond reasonable doubt:

1. Tailings discharged to Lake Superior by Reserve Mining are found in the western end of Lake Superior and occur in the sediments of Wisconsin. These deposits are discontinuous and are mixed with the surface layers of the bottom sediment of the lake. There is not a blanket over the western portion of the lake, except for an area near the point of discharge.

2. Tailings cause green water along the Minnesota shore, and there is an adverse public reaction to the aesthetic appearance of this coloration.

3. The tailings contribute measurable quantities of dissolved materials to the lake. Based on data supplied to the State of Minnesota by Reserve, this is a minimum of 20 tons per day. These materials provide measurable algal growth stimulation when in sufficient concentration, indicative of their nutrient value.

4. Tailings are biologically active as evidenced by effects on algae and bacterial growth.

5. With the data available to date, it does not seem probable that there are direct adverse effects on the fishes of Lake Superior or their food organisms, except near the discharge.

6. The bacterial and algal growth promotion and the contribution of dissolved solids from the tailings contribute in an adverse way to water quality.

7. Many materials contributed to Lake Superior water by the taconite discharge are contained in other discharges identified by this conference, and the control of the Reserve Mining discharge should be considered as one part of the basin-wide problem.

These effects must be put into perspective and balanced against still other considerations. Of all uses, regulatory agencies most often regard effects of pollutants on aquatic life as the most pronounced, but this is not true in Lake Superior. This conference stated that Lake Superior is a "priceless natural heritage" and that it is "to be preserved in its present state." To achieve these goals, every effort must be made to remove all possible sources of materials entering the lake. Data have been presented to this conference before demonstrating that an increase from 0.5 to 1.5 parts per million of suspended solids will reduce water clarity by severalfold. This is a change not worth considering in most lakes; neither are such changes likely to drastically alter the fishery of Lake Superior. But they will cause an obvious and undesirable change in the lake's blue color, aesthetic appeal, and water clarity.

In my judgment the effect of Reserve's discharge should be assessed in terms of altering the lake's appearance rather than the toxic effects on fish and fish food organisms or endangering water supplies. The discharge is one of many sources increasing the dissolved materials in the water and these materials provide some acceleration of the lake's aging process. Certainly the population and industrialization will increase in the basin and this growth will place an increased burden on Lake Superior. The decisions made now regarding the addition of persistent materials will affect the entire future history of Lake Superior.

As sanitary engineers and regulatory administrators, we have fooled ourselves and unthinkingly implied that secondary waste treatment of sewage will give a high quality effluent, but this effluent still contains high (relative to Lake Superior) concentrations of dissolved solids that also contribute to aging. The concentrations of sulphates, chlorides, calcium, sodium, nitrates and others, are much higher in secondary effluent than present concentrations in Lake Superior, and these sources, combined with ones from mining, paper manufacturing and clay erosion, will accelerate the increase in total dissolved solids and eventual eutrophication. We won't stop eutrophication, but we can reduce the rate.

Many say Lake Superior is too big to

contaminate. As a boy in Ohio I heard this said of Lake Erie, too, but now we know differently. I, for one, have been skeptical of the alleged effects of pesticides on fish and birds, but I must confess my mind has been changed by environmental recovery following the ban of DDT and dieldrin in Great Britain. Who of us here today would have believed five years ago that a few parts per trillion of DDT in Lake Michigan would result in seizure of coho salmon by FDA because the DDT concentrations in the flesh were unacceptably high? Who of us here would have predicted two years ago that the very small discharges of mercury into Lake St. Clair and Lake Erie would result in closing the commercial fishery of Lake Erie in order to guard against human consumption of fish containing an unacceptable amount of mercury?

Some here today believe that the present discharges to Lake Superior will not cause adverse changes in the lake. What are the chances that an effect like the DDT one in Lake Michigan will happen in Lake Superior, perhaps for a different pollutant? How many realized that the Welland Canal around Niagara Falls would result in the near loss of the lake trout fishery of Lake

Superior as a result of the lamprey?

We must consider Lake Superior as part of the Great Lakes and not isolated from them. Of course Lake Superior will not be affected by many events in the other Great Lakes, but events in Lake Superior will certainly affect them. The high quality water from Lake Superior must have a tremendous beneficial effect on Lake Erie and clearly nothing should be done to reduce that benefit.

In summary, I suppose the essence of what I have tried to say is that the effects of present discharges are small, but they are in the direction of degradation, mostly because the materials being added are persistent and the flushing rate of the lake is very slow. Their effects are irreversible and cumulative. The decision is, in reality, based on the question, should our plan of action protect for 50 years or 500 years or more? Historians may well record that the future of Lake Superior was cast by this conference. The conferees' responsibility is sobering.

Thank you. (Applause.)

(The foregoing report, with attachments, is as follows:)

SUMMARY OF EFFECTS OF TAILINGS ON LAKE SUPERIOR

Donald I. Mount, Ph. D., Director

NATIONAL WATER QUALITY LABORATORY
Duluth, Minnesota

During past sessions of this Enforcement Conference, statements have been made regarding the effects, on the ecology of Lake Superior, of taconite tailings discharged from Reserve Mining Company. The purpose of my presentation today is to attempt to identify important points which the National Water Quality Laboratory feels have been established beyond reasonable doubt. We have been conducting laboratory investigations regarding the chemical and biological behavior of tailings and we completed a sampling survey of Lake Superior bottom sediments last summer. Results of these studies are presented in technical reports that have been sent to each of the conferees in advance of this conference.

During the autumn of 1968, members of my staff studied, in some detail, the characteristics of green water that occurs along the Minnesota shore and is particularly noticeable in autumn and spring. The purpose was to identify the characteristics of green water and the source, if possible. As a result of these field and laboratory investigations, we found that green water contains approximately 1.5 ppm of suspended solids as opposed to clear water which contained .5 or less ppm of suspended solids. Attendant with this increase of suspended solids concentration is a reduction in light penetration by as much as 5 to 10 times. Divers report that when viewed at night using a flashlight beam, particles are visible in the green water in much the same way that dust particles can be observed in a sunbeam passing through dusty air. On some days, bands of green water extended in a continuous fashion from the Reserve discharge to many miles southwest of the plant, and there was no doubt in the minds of the divers observing the green water bands, that the source was Reserve Mining.

To provide objective data substantiating this observation, detailed analyses of the suspended solids were completed to identify the same, using the presence of cummingtonite, and the absence of clay minerals as indicators. The results established beyond reasonable doubt that these bands of green water were due to tailings suspended in the water.

Figure 1 shows the characteristic X ray diffraction patterns of the suspended solids in green water and of effluent from the plant.

Normal clay minerals are absent and the patterns are identical for both samples, suggesting a common source. Figure 2 shows characteristic X ray diffraction patterns for sediments from two tributaries to Lake Superior. Note the near absence of cummingtonite and the presence of normally found clay minerals. Other laboratory studies of the reflectance spectra of suspended tailings from green water indicated that the color would appear as yellow-green to the eye.

Green water masses sampled along the Wisconsin shore and caused by heavy rainfall and subsequent runoff, contained only a trace of cummingtonite but the normal clay minerals that are found in natural sediments were present. Since these analyses did not reveal the presence of tailings in green water masses along the Wisconsin shore, the results added confidence that the method of identifying tailings in Lake Superior water by the use of cummingtonite, is a valid one.

Other data were presented in the May session of this Enforcement Conference and established the presence of cummingtonite in the water supplies of several municipalities along the Minnesota shore. The significance of these findings is not that there is an adverse effect on water supplies, but that the per cent of tailings in the sediment of the water supplies decreased with distance from the Reserve plant, indicative that the source was from that discharge. Furthermore, sediment collected from the detention basin at the Duluth Lakewood Pumping Station in 1962 was negative for cummingtonite and therefore not tailings, but sediments obtained in 1969 were positive for tailings. These observations lend strong evidence that the source of the tailings could not have been from the insignificant use of them on the highway for ice control and highway fill.

Some were not convinced that the method was valid, so a core sampling program was developed to establish whether or not there were natural sources of cummingtonite in other parts of the Lake that might confuse identification of tailings. Undistrubed core samples were taken with conventional core sampling devices, quick frozen aboard the vessel, and brought to the laboratory for analysis. Sections of these cores were made and the measurements of cummingtonite and therefore tailings, were quantitative. The detailed results and statistical evaluations are presented in the technical report supplied to you. Traces of cummingtonite in tributaries had been found and reported previously, so it was necessary to quantify the amount present and contributed from natural sources. The bottom portions of the cores had the same per cent cummingtonite as the natural stream sediments from tributaries in Wisconsin and Minnesota. This established that the input of trace amounts of cummingtonite from tributaries has not changed for a long period of time and that our estimates of these trace amounts contained in stream sediment, are representative. Knowing the true amount of cummingtonite from natural sources, enabled us to positively distinguish the input from Reserve even though very minor amounts are found in stream sediment. The cummingtonite content of the upper layers of some cores is much higher, indicative of a more recent and new source of that mineral. Cores taken "down current" from the Reserve discharge and near the plant show as much as 30% cummingtonite (or as much as 75% tailings). The statistical analysis performed revealed that 7 of 14 cores from the Wisconsin side of the Lake contained tailings in the upper layers of the core. The per cent of tailings in lake sediment is low and deposition is discontinuous over the area southwest of the Apostle Islands. Tailings are mixed with the surface layers of sediment and are not as a blanket over the lake bottom. Figure 3 shows the relationship between depth of tailings within the core and depth of water, for a transect from Encampment Island to Herbster, Wisconsin. One can see that the tailings are being deposited primarily in the deep trough off the Minnesota shore and that on this transect no tailings were found in the Wisconsin portion of the Lake. Figure 4 shows a similar plot for a transect extending from Stoney Point to the Brule River. One can see that the tailings are deposited over a broad area of the Lake and in Wisconsin. This pattern may be caused by lake currents carrying suspended tailings out of the trough into more shallow water, forcing them to spread. This suggests a reason Wisconsin samples on the Encampment Island-Herbster transect, were negative. The obvious stratification of cummingtonite in the core establishes beyond reasonable doubt that the source is a recent one. In conjunction with the other data, this clearly identifies the source of cummingtonite as tailings, and demonstrates movement into a state other than that one in which the discharge originates.

Another investigation completed during the past winter at the National Water Quality Laboratory, was one to measure the direct toxic effects of taconite tailings on lake animals. For these tests, we utilized the liquid portion of the effluent and only the less than 2 micron tailings. This decision was made because we do not expect the coarser particles to be carried great distances in Lake Superior. The results of these tests have been presented in a technical report also.

Concentrations less than 10% (equivalent to 20 ppm of suspended solids), had no direct effects on the eggs of brook trout, lake trout or lake herring, nor were there significant effects on the reproduction of important plankton organisms such as Daphnia. The data for Mysis and Pontoporia are inconclusive, but suggestive that there may have been effects at lesser concentrations. Mortality in control tanks was higher than is normally acceptable for bioassays of this type, and so no significance can be attributed to these mortalities of these two invertebrates. Bioassay data clearly suggest that direct adverse effects of the tailings on fishes and fish food organisms will not occur at the concentrations expected in the Lake, except for local areas near the discharge and in the heavy density current.

Other tests were performed utilizing Lake Superior plankton to determine whether or not there is algal growth potential from the effluent. The results of these growth tests utilizing Lake Superior algae, at prevailing summer, surface temperatures, reveal that at 10% effluent (equivalent to 20 ppm suspended solids), there are slight growth promotion effects of the effluent as shown in Figure 5. These are not large, but do suggest that there is some nutrient value in the tailings and that a sufficient concentration produces a measurable increase in algal growth. These data do not suggest that there will be an algae bloom near the point of discharge, but indicate that materials are dissolving that provide nutrients for algal growth and that the tailings therefore should be considered as one source of nutrients in Lake Superior.

Still other tests were performed to determine the effect on the growth of bacteria of sanitary significance. E. coli, one of the most commonly used indicator bacteria and Klebsiella pneumonia, a human pathogen, were used as representative bacteria for the tests. Figure 6 shows the response of E. coli to tailings. One-tenth per cent effluent in Lake Superior water (equivalent to approximately .2 mg/l of suspended solids), compared to 100% lake water caused a significant decrease in the die away rate of E. coli, and 1% produced a luxurient growth of bacteria. Figure 7 shows the response of Klebsiella to taconite tailings and in this case, there was no response at .1%, but a significant response at 1% (equivalent to 2 mg/l). These tests suggest strongly that bacteria discharged into the Lake will live longer or even grow, in the presence of tailings. Most importantly however, these tests demonstrate that the tailings are biologically active and that they are not inert. At the present time, known discharges of bacteria to Lake Superior are not numerous and the number should be reduced when adequate treatment is provided. There is no implication from this data that we should expect to see a bacterial problem in Lake Superior if discharges containing bacteria are adequately controlled.

Solubility studies were also made to establish the rate of solution of tailings in Lake Superior water. Some solubility studies were performed at summer temperatures in order to accelerate the rate of solution and to compress the experimental period into a shorter time span. The results of some of these studies are presented in Figure 8. You can see a rapid increase in dissolved materials as the water passes through the plant and a much slower rate of solution during the next 28 days. Various dissolved solids increased from 1.5 to 18 times over those in lake water. Figure 9 shows the increase in conductance of the water in contact with tailings. During a period of 90 days, conductance, an indicator of total dissolved solids, increased from 30 to 70%, depending on the suspended solids concentration. Other tests measured solubility of total tailings effluent, in 5-gal. carboys at 6° C (a typical lake temperature for the bottom of the Lake), for a period of 332 days. These provided a more realistic picture of the solubility rate that might be expected from tailings settled on the Lake bottom. This experiment was unrealistic in that there were no water currents in the jugs to mix the dissolved material. These data show increases up to 100% in the dissolved silica, sodium, potassium, calcium and magnesium, indicating that even in the absence of currents and when settled on the bottom, the tailings do dissolve slowly. Increases of dissolved solids in interstitial water were much larger.

Since Reserve reported preliminary data on bottom fauna studies in May, we did not conduct additional sampling surveys in the Lake, but we look forward, with great interest, to hearing at this conference the results of those studies.

Unfortunately, it was not possible to conduct the experimental work designed to determine whether or not important fishes in the Lake, such as lake herring, avoid green water. These studies would have been helpful in assessing the significance of green water along the Minnesota shore and in verifying the alleged effects on commercial fishing.

The data presented do not clearly reveal the impact of tailings on Lake Superior. I have had numerous discussions with my staff regarding the probable impact of tailings on Lake Superior, viewed in light of the data currently available. We are fully aware of the serious consequences of failing to adequately protect Lake Superior from man made discharges and we are also keenly aware of the expensive disposal methods which would have to be employed in order to eliminate this discharge. With these important considerations in mind, and in light of the scientific data presently available, we believe that the following points are established beyond reasonable doubt:

1. Tailings discharged to Lake Superior by Reserve Mining are found in the western end of Lake Superior and occur in the sediments of Wisconsin. These deposits are discontinuous and are mixed with the surface layers of the bottom sediment of the Lake. There is not a blanket over the western portion of the Lake, except for an area near the point of discharge.

2. Tailings cause green water along the Minnesota shore, and there is an adverse public reaction to the aesthetic appearance of this coloration.

3. The tailings contribute measurable quantities of dissolved materials to the Lake. Based on data supplied to the State of Minnesota by Reserve, this is a minimum of 20 tons per day. These materials provide measurable algal growth stimulation when in sufficient concentration, indicative of their nutrient value.

4. Tailings are biologically active as evidenced by effects on algae and bacterial growth.

5. With the data available to date, it does not seem probable that there are direct adverse effects on the fishes of Lake Superior, or their food organisms, except near the discharge.

6. The bacterial and algal growth promotion and the contribution of dissolved solids from the tailings contribute in an adverse way to water quality.

7. Many materials contributed to Lake Superior water by the taconite discharge are contained in other discharges identified by this conference and the control of the Reserve Mining discharge should be considered as one part of the basin-wide problem.

These effects must be put into perspective and balanced against still other considerations. Of all uses, regulatory agencies most often regard effects of pollutants on aquatic life as the most pronounced, but this is not true in Lake Superior. This conference stated that Lake Superior is a "priceless natural heritage" and that it is "to be preserved in its present state." To achieve these goals, every effort must be made to remove all possible sources of materials entering the Lake. Data have been presented to this conference before demonstrating that an increase from .5 to 1.5 ppm of suspended solids will reduce water clarity by several fold. This is a change not worth considering in most lakes; neither are such changes likely to drastically alter the fishery of Lake Superior. But, they will cause an obvious and undesirable change in the Lake's blue color, aesthetic appeal, and water clarity.

In my judgment the effect of Reserve's discharge should be assessed in terms of altering the Lake's appearance rather than the toxic effects on fish and fish food organisms, or endangering water supplies. The discharge is one of many sources increasing the dissolved materials in the water and these materials provide some acceleration of the Lake's aging process. Certainly the population and industrialization will increase in the basin and this growth will place an increased burden on Lake Superior. The decisions made now regarding the addition of persistent materials will affect the entire history of Lake Superior.

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Many say Lake Superior is too big to contaminate. As a boy in Ohio I heard this said of Lake Erie, too, but now we know differently. I, for one, have been skeptical of the alleged effects of pesticides on fish and birds, but I must confess my mind has been changed by environmental recovery following the ban of DDT and dieldrin in Great Britain. Who of us here today would have believed, five years ago, that a few parts per trillion of DDT in Lake Michigan would result in seizure of coho salmon by FDA because the DDT concentrations in the flesh were unacceptably high? Who of us here would have predicted two years ago, that the very small discharges of mercury into Lake St. Clair and Lake Erie would result in closing the commercial fishery of Lake Erie, in order to guard against human consumption of fish containing an unacceptable amount of mercury?

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We must consider Lake Superior as part of the Great Lakes and not isolated from them. Of course Lake Superior will not be affected by many events in the other Great Lakes, but events in Lake Superior will certainly affect them. The high quality water from Lake Superior must have a tremendous beneficial effect on Lake Erie and clearly nothing should be done to reduce that benefit.

In summary, I suppose the essence of what I have tried to say is that the effects of prerent discharges are small, but they are in the direction of degradation, mostly because the materials being added are persistent and the flushing rate of the Lake is very slow. Their effects are irreversible and cumulative. The decision is, in reality, based on the question, should our plan of action protect for 50 years, or 500 years, or more? Historians may well record that the future of Lake Superior was cast by this conference. The conferees' responsibility is sobering.

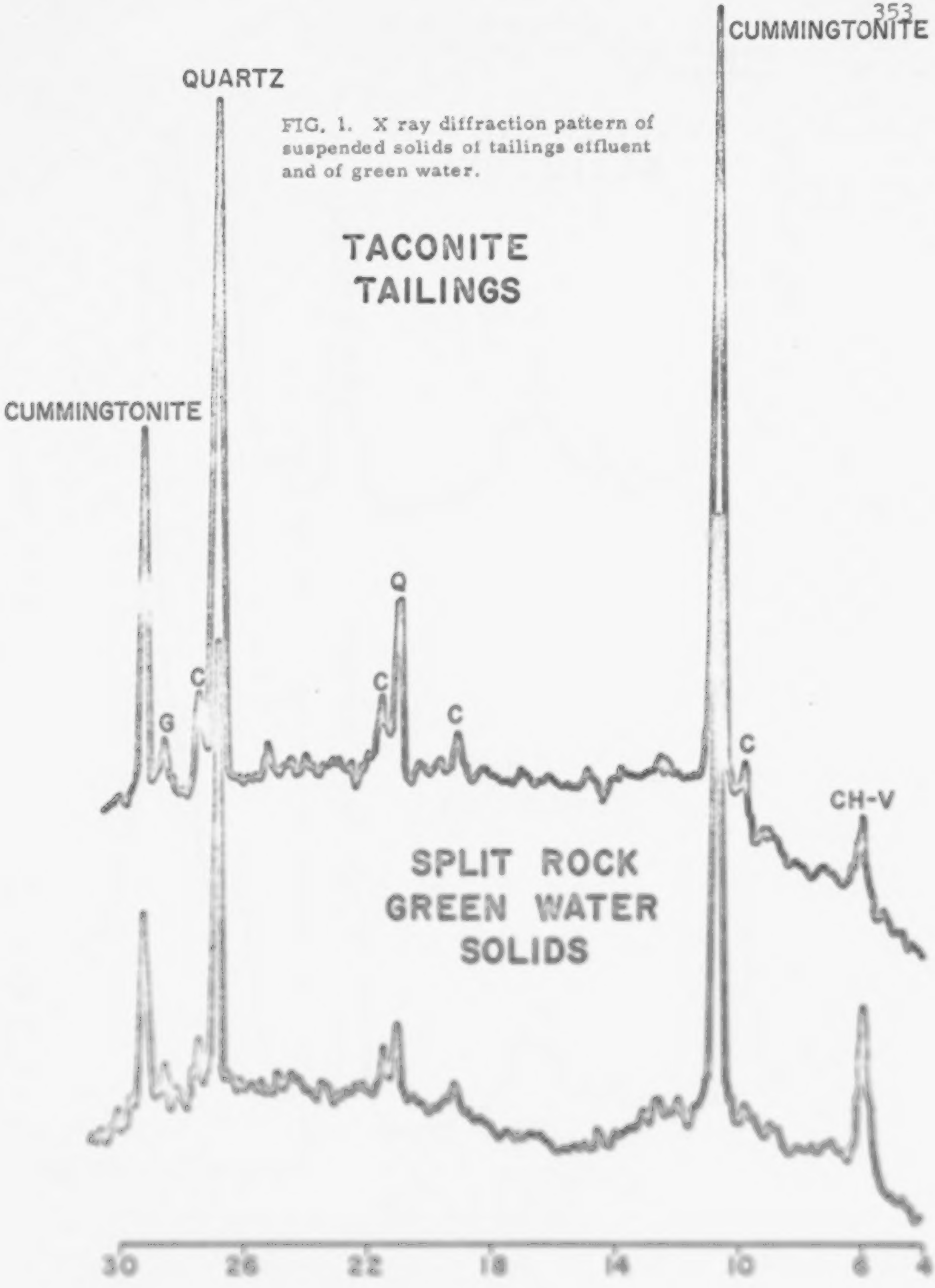
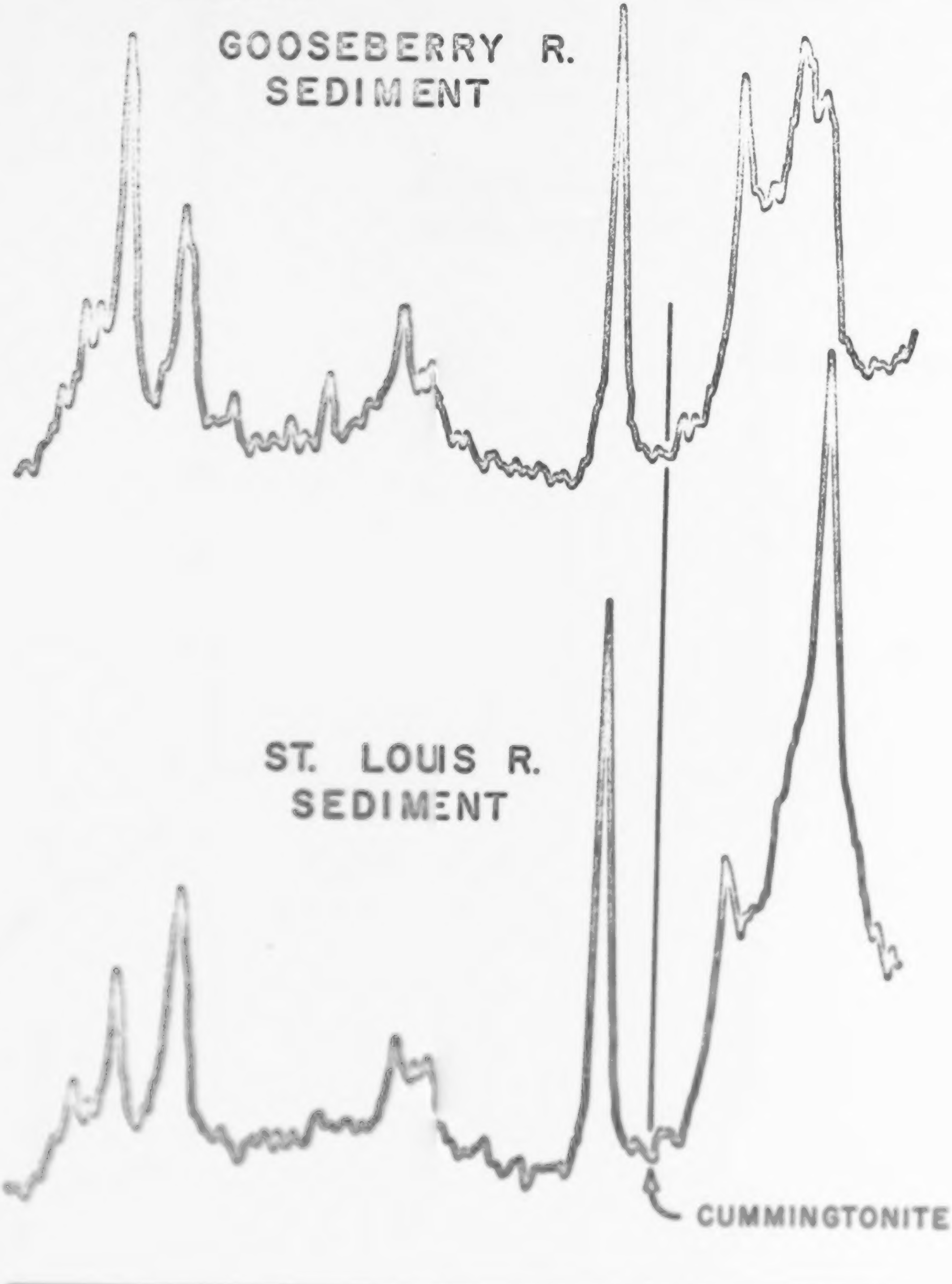


FIG. 1. X ray diffraction pattern of suspended solids of tailings effluent and of green water.

FIG. 2. X ray diffraction patterns of suspended solids from tributaries to Lake Superior.



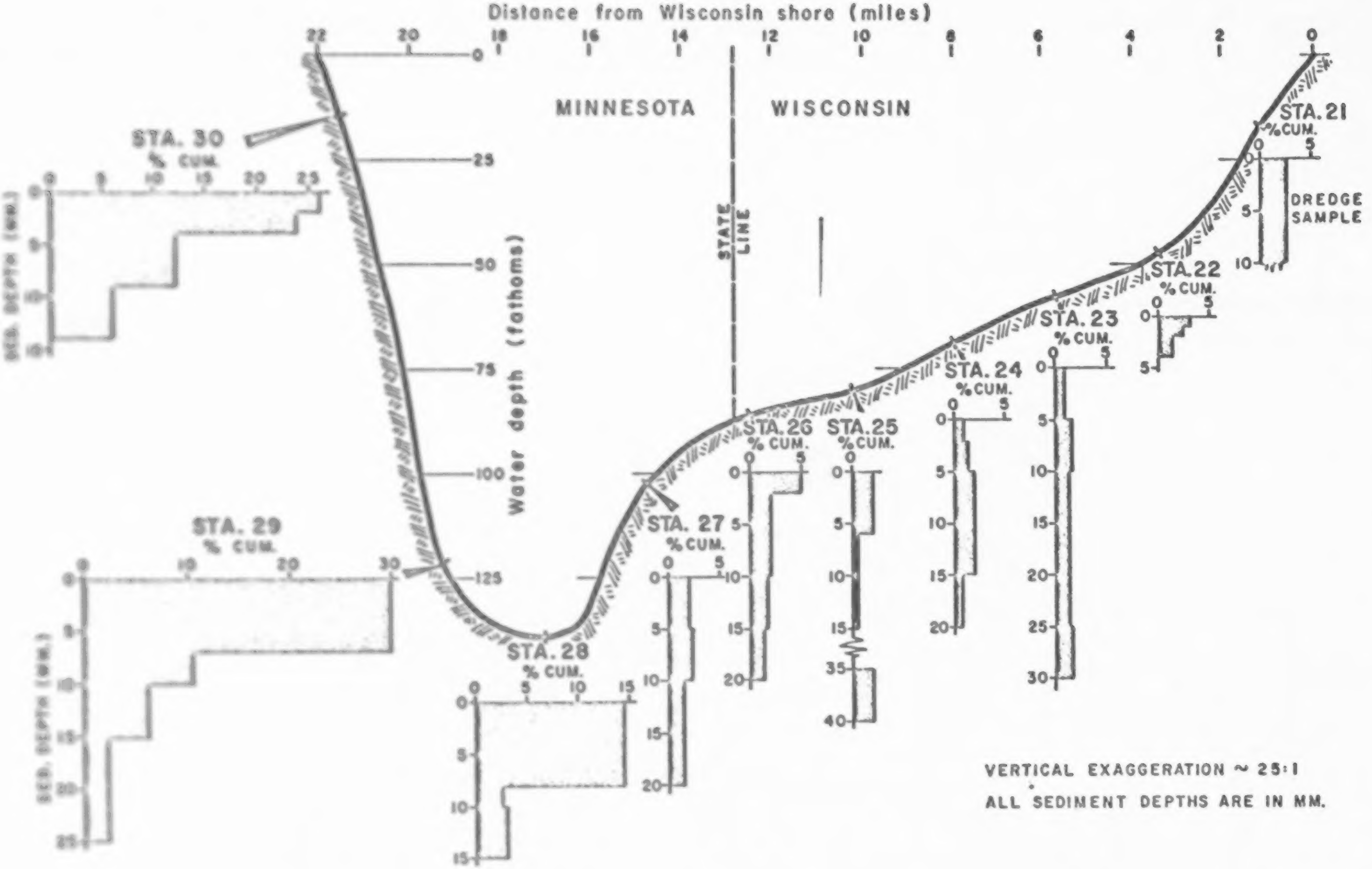


FIGURE 3. ENCAMPMENT ISLAND TO HERBSTER WIS. TRANSECT SHOWING THE RELATIONSHIP OF % CUMMINGTONITE TO SEDIMENT DEPTH IN CORE SAMPLES.

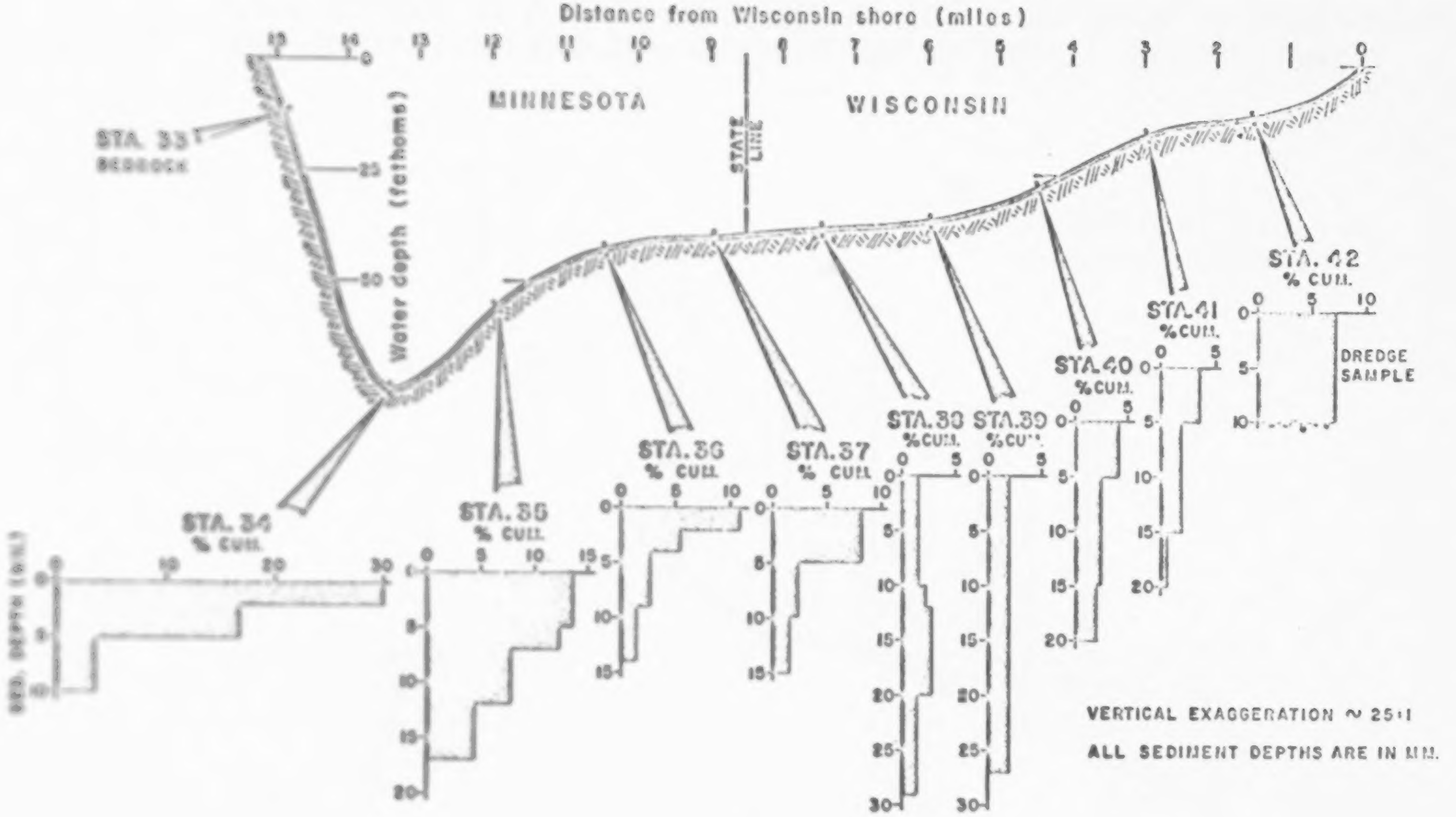


FIGURE 4. STONEY POINT, MINN. TO BRULE RIVER, WIS. TRANSECT SHOWING THE RELATIONSHIP OF % CUMMINGTONITE TO SEDIMENT DEPTH IN CORE SAMPLES.

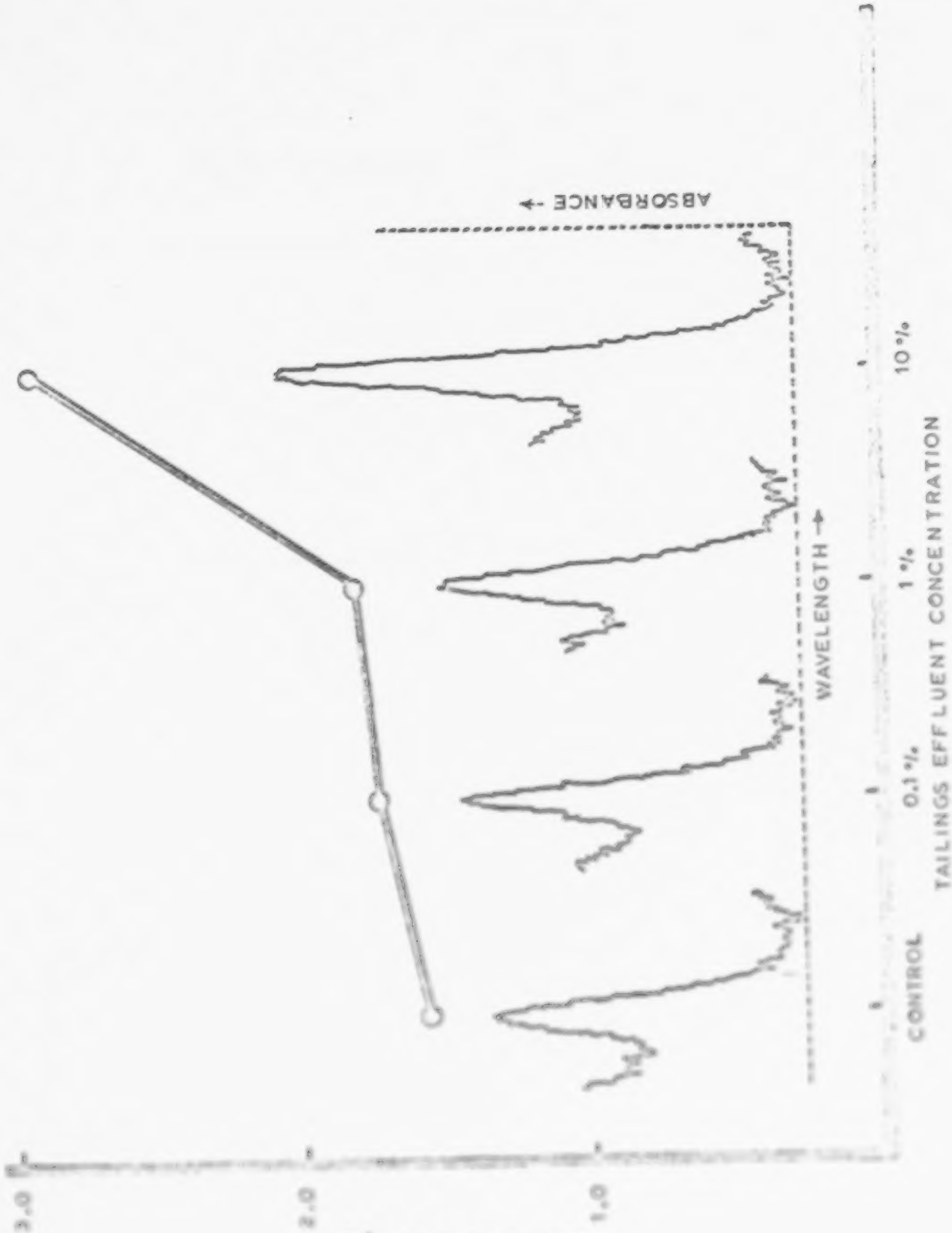


FIG. 5. Chlorophyll-a content and spectra (6630 Å region) versus taconite tailings effluent concentration.

FIG. 6. Growth response of E. coli to tailings.

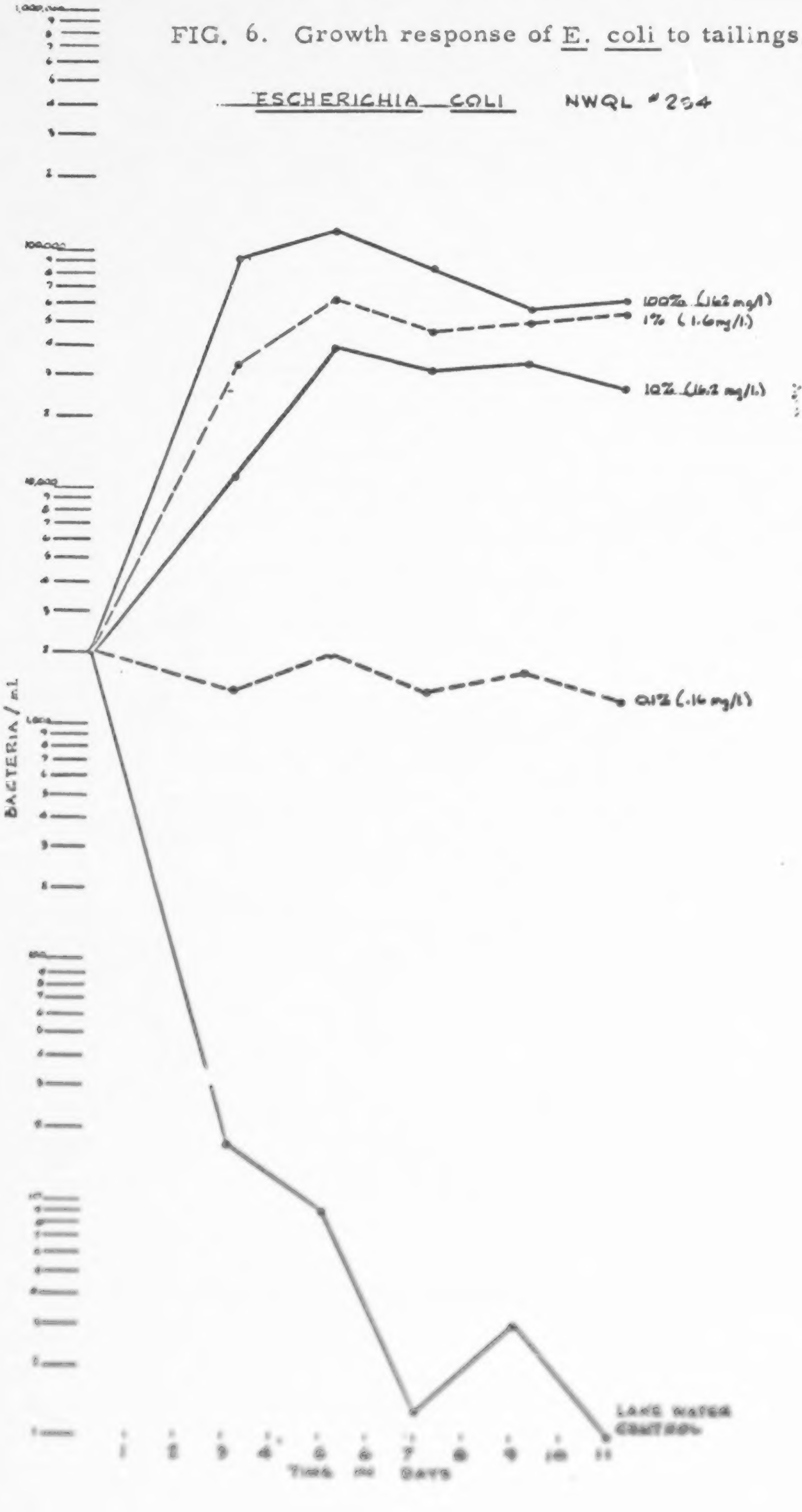


FIG. 7. Growth response of K. pneumonia to tailings.

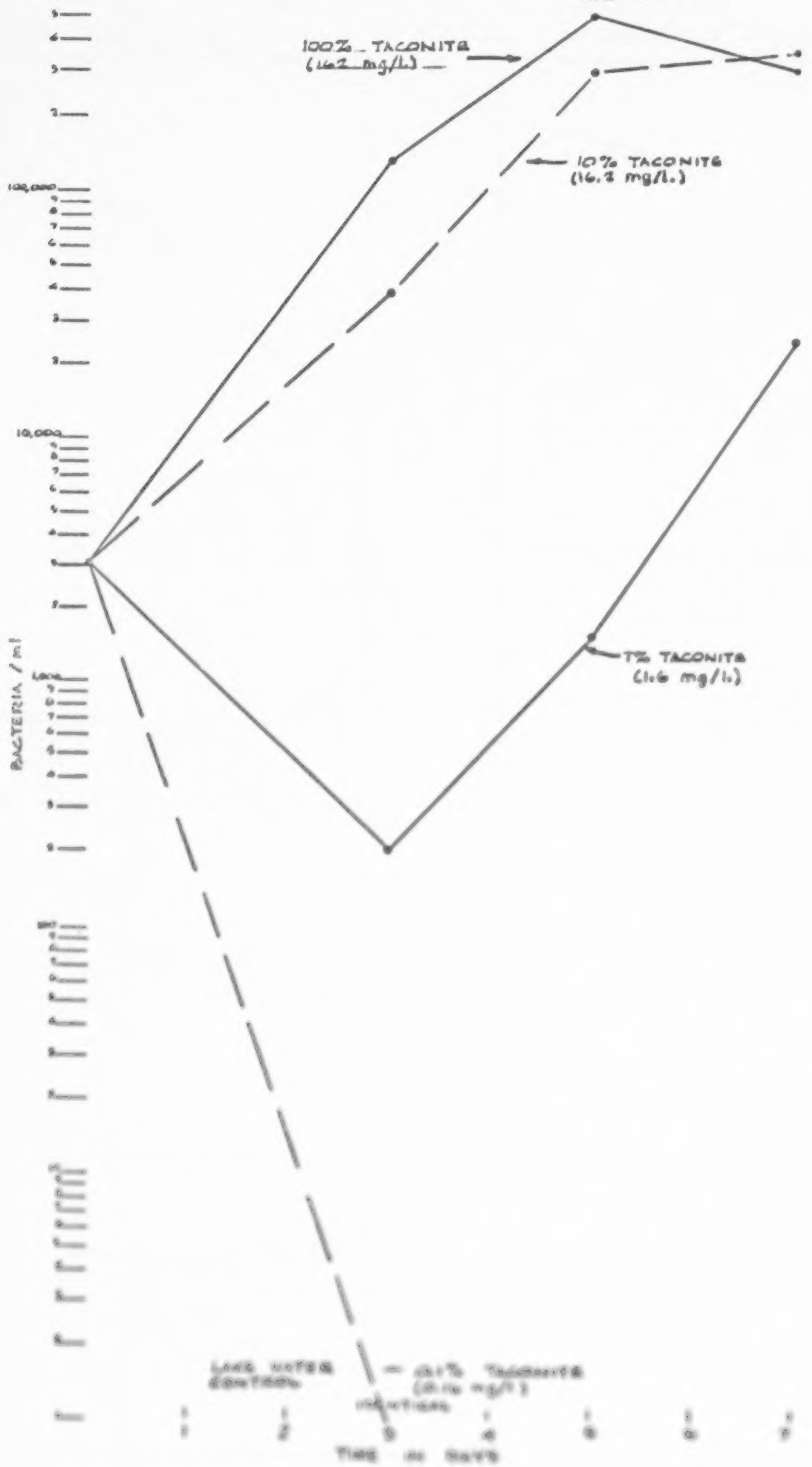
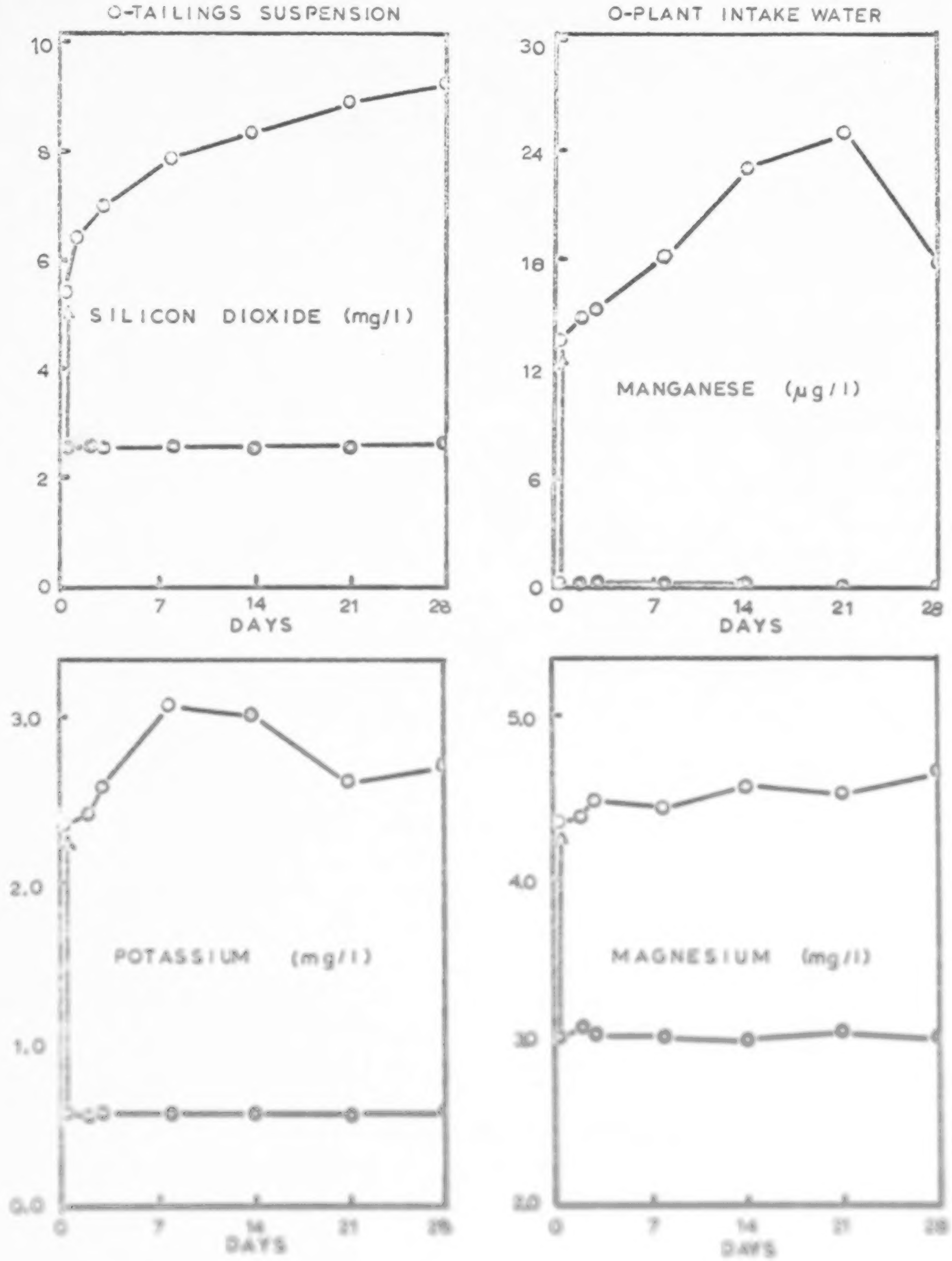


FIG. 8 Chemical analyses of taconite tailings effluent versus days at 6° C.



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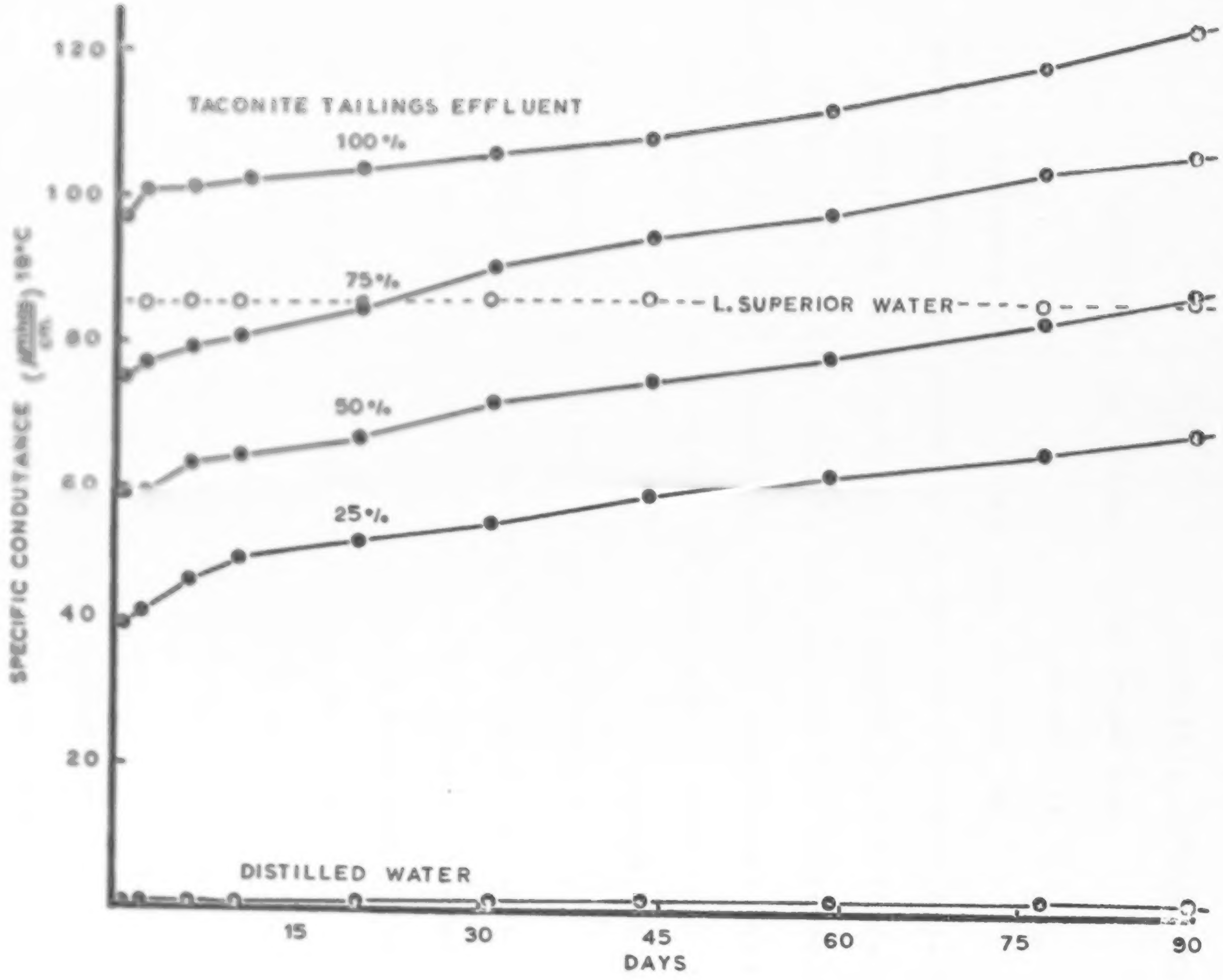

FIG. 9. Specific conductance of taconite tailings effluent versus days at 20° C.

MR. STEIN: Thank you for a very comprehensive and careful statement.

Are there any comments or questions?

Mr. Purdy.

MR. PURDY: Mr. Stein, I feel somewhat frustrated here. I was trying to relate the problems with respect to the Reserve Mining Company to problems of interstate pollution, the subject that I think is of prime importance to this conference, to determine whether in fact such discharges are subject to the control of this conference.

I can recognize the value of the priceless natural heritage of the lake as it is, but again is this a matter that is under the Federal Act that is actionable under interstate pollution?

MR. STEIN: Well, that is a conclusion we have to get. But let's ask Dr. Mount to answer that. I was looking at the same point. Let's try to work on this together.

Dr. Mount, let's see if you can help us on this. You indicate that these--one of your--I can't put my finger on it, but you can. Oh, here is where it says:

"1. Tailings discharged to Lake Superior by Reserve Mining are found in the western end of Lake Superior and occur in the sediments of Wisconsin."

Would you explain that without the conclusion?

DR. MOUNT: Well, I am not sure I can say it any better than I have tried to say it already. But we are simply saying that they are moving from Minnesota to Wisconsin and they are circulating through this end of the lake.

MR. STEIN: Yes. Let me see if I can paraphrase this, and why don't you check me, Mr. Purdy.

As I understand your statement, Dr. Mount, you are saying that the tailings discharged into Lake Superior by Reserve Mining find their way to Wisconsin; that these tailings are biologically active and promote the growth of algae.

Have I overstated that?

DR. MOUNT: In proper concentrations and also bacteria.

MR. STEIN: Yes, and also bacteria.

All right. Now, presumably in proper concentrations in Wisconsin?

MR. PURDY: That is what bothers me.

DR. MOUNT: We have not made measurements in the water, but it certainly seems reasonable to me that concentrations in the order of less than a half a part per million would be expected to occur in Wisconsin from time to time, not necessarily in all of the water nor all of the time.

MR. STEIN: You would expect that the concentrations in Wisconsin of taconite tailings caused by the activities of Reserve Mining would from time to time--I am just restating this; you can do it--from time to time would create biologically active conditions which would lead to the growth of algae and bacteria. Is this a fair statement of what you have said?

DR. MOUNT: I can only express an opinion and that is that I would expect concentrations in the range of a half a part per million or less to occur at times in Wisconsin, and our recent tests with bacteria have shown that this accelerates their growth rate.

MR. STEIN: I can draw a conclusion here, but I would rather have you do it. Let me ask this: In your opinion, do you believe that from time to time in Wisconsin waters there occurs taconite tailings caused by the discharge of wastes from Reserve Mining which results in bacterial activity which causes accelerated algal and bacterial growth?

DR. MOUNT: I am not trying to avoid that question. Maybe I am. (Laughter.)

I am looking at Figure 4 and I see there that there are concentrations in the range of 10 percent in the surface sediments very near the State line, and I would certainly expect to find such concentrations in Wisconsin in that area that most probably would promote some bacterial growth.

MR. STEIN: How about algal growth?

DR. MOUNT: I wouldn't want to venture an opinion on that one, not with our present information.

MR. STEIN: All right.

MR. PURDY: Mr. Stein, I have several questions that relate to this that I would like to run down through just for clarification in my own mind.

You discuss the green water phenomena. Now, is this limited to Minnesota waters?

DR. MOUNT: As far as our measurements are concerned. The measurements that we did make in Wisconsin on one date did not contain tailings, in our judgment.

MR. PURDY: Just for my own information, you mentioned divers' report. I am wondering who the divers were.

DR. MOUNT: Mr. Jack Arthur, who is present today; Mr. Duane Benoit I think is here.

MR. PURDY: These were people on your staff?

DR. MOUNT: My staff, yes. And Mr. Wesley Smith. And we have slides which we could have brought of that.

MR. PURDY: You mentioned the presence of tailings in water supplies. Again is this limited to Minnesota water supplies?

DR. MOUNT: Yes, it was. We found them only in Minnesota waters.

MR. PURDY: You mentioned the adverse effects of the tailings on fishes and fish food organisms as occurring in the local areas near the discharge and in the heavy density current. The 9-square-mile area has been referred to in many other cases. Would this be contained within this 9-square-mile area or would it extend outside of this?

DR. MOUNT: As I indicated, we didn't make bottom fauna studies. I refer you or remind you again of the State report in which, as I recall, the organism counts of Pontoporeia were somewhat higher nearer the discharge and diminished at a greater distance from the plant. There is no question, I believe, from the information supplied by the company to the State and contained in several reports that the pile of tailings identifiable in at least tenths of inches in depth extends for some considerable miles beyond that, I am not sure whether it is 10 or 15 or some distance like this. As I indicated, Reserve has completed, as I understand it--well, they reported in the May session that they were doing some bottom fauna studies and I would hope that we will hear from them in regard to the effect on organisms that they found.

MR. PURDY: Then the report discusses the measurable increase in algal growth. Would you consider these in the same context as, say, phosphorus discharged from Munising, Michigan, that this is contributed to the lake and mixes with the lake water as a whole and so, therefore, contributes to accelerated rate of eutrophication of the lake as a whole?

DR. MOUNT: We were not able or did not identify the particular element or mineral which caused the increased algal growth, but we believe that there is nutrient value in these tailings, and I would see no reason why this contribution would not enhance contributions from other known sources of nutrients. If you have detailed questions on this, I think perhaps Dr. Bartsch ought to handle those since he is more familiar with the algal growth than I.

MR. PURDY: I am not so concerned about the specific element, but would it be considered to have the same effect as some other specific element discharged at some other point in the lake that we say mixes with the lake water as a whole and therefore is of interstate significance?

DR. MOUNT: I would think that it would have a contributing effect or an additive effect.

MR. PURDY: That is all. Thank you.

MR. STEIN: Are there any other comments or questions?

MR. MAYO: Yes, I have a few questions, Mr. Chairman.

Dr. Mount, would you elaborate on your Conclusion No. 7 as to the relationship of the Reserve discharge to other discharges on the lake?

DR. MOUNT: Yes. The Chairman, Mr. Stein, asked me in October about the significance of something added to the lake and whether it might affect the lake in some other place. What we are trying to say in this Conclusion No. 7 is that we cannot consider Reserve as being the only source of materials that affect this lake and that other discharges, which I identified in my statement, are also contributing similar materials, and these should receive careful attention too and be considered in light of all discharges and not just a single one.

MR. MAYO: One other question. In the summary report that you presented you mentioned the significance of the tailings with respect to Klebsiella pneumonia. Why was that organism chosen?

DR. MOUNT: Mr. Chairman, if it is all right, I would like to ask Dr. Donald Herman of my staff to answer that question.

Dr. Herman.

DR. HERMAN: I am Donald Herman, Research Microbiologist with the National Water Quality Lab.

The question was why we selected Klebsiella pneumonia as one of the test organisms. Well, for years in judging pollution effects on our waters we have used the coliform organisms as an indicator. They have been covered as a group. In this case, since we did find the Klebsiella pneumonia organism within the basin area, it was isolated from waters within the basin and also was confirmed by the National Communicable Disease Center, I included this as an example of the pathogenic type organism as well as our work with E. coli, which is well recognized as an indicator organism.

MR. MAYO: How significant is the Klebsiella pneumonia organism in the basin; how significant is this in the basin?

DR. HERMAN: In the basin, I could not say for the basin as a whole. I found this isolation in one area within the basin. As you realize, with a limited staff and limited time, we have not had the time to check other areas of the basin. But this is one case where the

Klebsiella pneumonia was a pathogenic organism that was found within the water within the basin, so it exists as a typical example of an organism that we know can be found in areas of Lake Superior.

MR. MAYO: Thank you.

MR. STEIN: Mr. Frangos.

MR. FRANGOS: Yes. First let me congratulate Dr. Mount on an excellent summary of an awful lot of work and investigation.

I would like to inquire about this question of the tailings providing nutrients or algal growth. I am wondering, can you give us some kind of a comparison as to the potential contribution of tailings and let's say other sediments?

DR. MOUNT: Dr. Glass, would you care to answer that question? I think you have made some comparisons with tributaries.

DR. GLASS: My name is Gary Glass, National Water Quality Lab.

I conducted the dissolution experiments which make up Report No. 6. I believe the question is how do the nutrients which stimulate algae, or in this case diatoms, compare with other nutrients within the basin?

If one considers the approximate increases that I measured, these increases multiplied, times the total volume or the total amount that, say, Reserve puts out in one day compared with the St. Louis River, for instance, the St. Louis River is approximately--oh, I think it is the largest stream entering the lake and certainly is the largest in this area or in the western end of the lake--compared the Reserve amount of silica, silicon dioxide, with the St. Louis River, the amount found is approximately 40 percent of the input of the St. Louis River. Now, the 40 percent number is a very approximate number based on the numbers of the results of my dissolution experiments.

My dissolution experiments give a minimum amount of silica which will be added by the Reserve Mining Company. These numbers could be increased or probably would be increased by simulating the effects of Lake Superior on the tailings themselves. I would have to--well, I would describe my experiments which used these 5-gallon carboys, no stirring or mixing of these sediments to derive these silicon dioxide numbers.

But in general or to recap, in terms of the growth stimulation that was found for diatoms, the silica appears to be the component which caused this growth increase, and comparing the daily output of the Reserve with the St. Louis River, Reserve corresponds to be at a minimum 40 percent of the St.Louis River. These are based on gross estimates.

Does that answer your question? The number may be closer to 80 percent in reality.

MR. FRANGOS: Well, then, I conclude that we have got a very significant problem, looking at the whole sedimentation problem in the lake. There was some question, at least when we started our inquiry here, about the solubility of silica and its stimulating effect. Shouldn't we be raising that same question with other minerals that are contained in these sediments?

DR. GLASS: I believe the answer is yes.

MR. FRANGOS: So we have a real interest in controlling this whole erosion business, don't we?

DR. GLASS: Certainly.

DR. MOUNT: Mr. Frangos, I would like to point out again, I think it is very important that the algal growth studies which we have reported are only a small number of experiments, and I don't think we should make world-shaking conclusions on that amount of data. I think they do suggest very strongly that there is algal growth promotion. Whether or not it is due to one particular material in it, I think we have not established that at all.

MR. FRANGOS: Well, the decisions may be somewhat earth-shaking.

I would like to ask the same question about bacteriology. I noticed we talked about the tailings are biologically active and hence in some way can stimulate bacterial growths. Could we not say the same thing perhaps or ask that question about, again, other sediment materials?

DR. GLASS: The stimulation of bacteria could be caused by several factors, none of which we have looked at individually. There could be just the physical effect of having the substrate present which would promote the growth also in addition to the nutrients which could be added or derived from the tailings. These points are of academic interest insofar as tailings are being added to the lake and do materially increase, say, close to the plant the suspended solids, so regardless of what the specific cause of the increase is, the fact remains that they do stimulate bacterial growth.

MR. FRANGOS: Fine, but there may be other materials that similarly stimulate this kind of growth.

DR. GLASS: Oh, certainly. You might derive the same thing from the sediments.

DR. MOUNT: I think this is a very significant point, that we are not dealing with an isolated effect. I believe that is very important.

MR. MACKIE: Dr. Mount, with relation to your Conclusion No. 5 relative to direct adverse effects on the fishes of Lake Superior or their food organisms, have your investigations led you to believe that there may be indirect effects?

DR. MOUNT: I am sorry, I missed the last part.

MR. MACKIE: Have your investigations led you to believe that there may be indirect or possible long-range effects?

DR. MOUNT: Oh, we have not measured that, but I certainly would think if changes such as the nutrient inputs are enough to cause a change in the plankton, for example, there would be no question that we would see changes in the fishes. And this is why I worded that very carefully and said direct toxic effects.

I think, for example, again, when we see more of the bottom fauna data we may--we certainly have seen already in the State of Minnesota data, at least, their attributing effects to the bottom organisms, in this case Pontoporeia. So I think we should certainly leave that open as a distinct possibility.

MR. STEIN: Are there any further comments or questions?

Mr. Frangos.

MR. FRANGOS: Just one more question and I would like to just review this.

My recollection is that at the last conference we were very much interested in the data presented in the discussions dealing with the effects on the shrimp in that localized area in Minnesota. Now, did we not--at least didn't we have the suggestion that because this does have an indirect effect on the fisheries in that locality and because of the way fishes lived in the lake that it was affecting the lake as a whole?

DR. MOUNT: I think that it is very important to recognize that in Lake Superior much of the food production, as will be pointed out later in this conference, I am sure, does occur only at certain water depths and these are by and large limited to the shore areas and certain other shallow areas. So the effect in terms of the percent of the lake--an area affected, expressed in terms of the percent of the total lake, is not a fair comparison if one is looking at the production of food organisms. And so we cannot consider the lake as being made up of State boundaries, as I said before, or isolated pieces. It must fit together, and what happens in one part of the lake will affect or may affect what happens in another part.

MR. STEIN: Are there any further comments or questions?

Mr. Purdy.

MR. PURDY: Yes.

Dr. Glass, relating back to the question asked by Mr. Frangos, you estimated some 40 to 80 percent increase--or not increase--equivalent to the St. Louis

River. When you estimated the effects of the tailings, are you assuming that, say, the total daily discharge of tailings would be in surface contact with water for dissolution in the water or are you assuming that some will be covered and not be in contact with the water?

DR. GLASS: The 40 percent estimate corresponds to assuming that 45 percent of the tailings remain on the delta and 55 percent go down the slope into the lake. And this also does not include the water in the 45 percent which is already enriched. It just takes that gross fraction 55 percent of the total; and if you include the water from the 45 percent of the delta, it will get you about 60 percent; and if you make a few other modifying assumptions, you will raise the estimate to 80 percent of the silica in the St. Louis River. This is based on the St. Louis River having an average flow of 2,200 cfs and with the geological survey data approximating the silica content of about 6 parts per million. This is over a 6-months period that they measured the silica.

MR. PURDY: I think one of the complexing problems that again this indicates is that any sort of wet process to handle tailings will cause some dissolution of the silica into the carrying-water vehicle. Even if you went to a wet tailings pond and retained the tailings in a pond on land, you would still have some of the carryover of this dissolved silica now going into the lake.

DR. GLASS: This is correct. The dissolution rate, however, will be slowed as the amount of silica builds up in this process water. If you were to recirculate the process water, say, from a tailings pond, say if you recirculated it 10 times, you would not build up 10 times the amount of silica that one sees now. It would approach the equilibrium value of silica in the receiving water and then tend not to dissolve as rapidly as though there was no silica present.

MR. PURDY: Thank you.

MR. STEIN: Are there any other questions or comments?

Let's see, Dr. Mount is still there. Let me refer to a statement you have on page 5. You say:

"Since Reserve reported preliminary data on bottom fauna studies in May"--I assume that means last May?

DR. MOUNT: Yes.

MR. STEIN: --"we did not conduct additional sampling surveys in the lake"--in other words, we didn't take any action for a year--"but we look forward, with great interest, to hearing at this conference the results of those studies."

Now, you mean you got the preliminary results and you haven't heard a thing from them yet?

DR. MOUNT: I haven't seen anything.

MR. STEIN: Well, who do you expect to put in the-- In other words, we suspended the Federal and State governmental operations depending on Reserve, which they were going to--and we got preliminary results last May. We didn't do anything? We haven't heard one word from them for a year?

DR. MOUNT: As I said, Mr. Chairman, I have not received anything.

MR. STEIN: Who do we expect to put in the material about the fish foods being killed, such as the shrimp in particular areas, if you are not going to get it from this?

DR. MOUNT: As I indicated, I hoped that Reserve would report this at this conference.

MR. STEIN: But if they don't, we are not going to have the information, right?

DR. MOUNT: I don't believe Reserve would withhold information like that.

MR. STEIN: I don't believe they would withhold it, but we have no notion of whether they have it. Are you confident they have it and are going to produce it?

DR. MOUNT: I only know what was said at the May conference--that these were preliminary results and they would continue with the bottom fauna studies. I believe the record will bear me out on that.

MR. STEIN: And you are confidently expecting that they will produce those at this conference here today and tomorrow?

DR. MOUNT: I hope they will.

MR. STEIN: All right. Well, if they don't what are we going to do?

DR. MOUNT: Drop back 40 and kick, I guess. (Laughter.)

MR. STEIN: Well, I am optimistic with you and I am sure that your faith in Reserve is not misplaced and we are going to get this tomorrow.

Are there any other comments or questions?

If not, we will stand recessed until 9:30 tomorrow morning.

(Whereupon, at 5 o'clock an adjournment was taken until 9:30 o'clock, April 30, 1970.)

MORNING SESSION

THURSDAY, APRIL 30, 1970

(9:30 o'clock)

MR. STEIN: We stand reconvened.

I would like to read a telegram which presumably should have been here yesterday but we did not get it.

Addressed to me, the telegram reads as follows:

"In a telegram yesterday to the Chief of the United States Army Corps of Engineers, I once again urged the Corps to cancel its present permit allowing Reserve Mining Company to dump its tailings into Lake Superior and to base any future permit to Reserve on the adoption of plans that guarantee the expeditious and complete elimination of the tailings pollution of the lake." (Applause.)

"In a commendable step in February, the Secretary of the Interior urged a similar approach in his letter to the Chief of the Corps with department recommendations. By any or all of the means available to Federal and State authorities, including court action if necessary, this pollution of the lake must be stopped. The evidence presented this month by Federal reports that the tailings cover areas in a 1,000-square-mile portion of Lake Superior, including Wisconsin as well as Minnesota waters, is further confirmation of the serious and interstate nature of this discharge. The threatened environmental consequences are similar to those that have all but destroyed Lake Erie and are threatening Lake Michigan. The cost to society of the pollution of Lake Superior and the cost in economic as well as other terms to the local area and the region would be immeasurable. There is no way to replace this resource, no way to compensate for its destruction.

"By comparison, the costs of controlling the Reserve discharge are minimal and preliminary studies by the company's consultants confirm the feasibility of on-land disposal of the tailings, as did a United States Bureau of Mines study.

"This matter is a classic test of our willingness in this country to establish a national commitment to restore and protect the quality of our environment. If we are unable of unwilling to protect the integrity of the largest and most significant freshwater lake in America, there is serious doubt that we will meet the grave challenge posed by our national environmental crisis."

Signed Senator Gaylord Nelson. (Applause.)

We also have some things to clear up from yesterday before we proceed with calling on the States.

Mr. Bryson.

MR. BRYSON: There is one additional statement by the Federal Water Quality Administration. This deals with vessel waste legislation that has recently passed Congress. Mr. Gamet will read the legislation into the record.

MERRILL GAMET, CHIEF
FEDERAL ACTIVITIES COORDINATION BRANCH
GREAT LAKES REGION, FEDERAL WATER QUALITY
ADMINISTRATION, CHICAGO, ILLINOIS

MR. GAMET: Mr. Chairman, conferees.

(The following statement was read by Mr. Gamet:)

FEDERAL VESSEL WASTE LEGISLATION

Congress has passed a bill to further amend the Federal Water Pollution Control Act to control pollution from vessels within the navigable waters of the United States. The law applies to any vessel used, or capable of being used, on the navigable waters of the U.S. New vessels are units whose construction starts after promulgation of the standards called for by this law, and existing vessels are units whose construction started prior to the promulgation of the standards. The law also applies to U. S. vessels unless excepted by the Secretary of Defense in the interest of national security.

Not later than 2 years after enactment of the law the Secretary of the Interior, after consultation with the Coast Guard, shall promulgate Federal Standards of performance for marine sanitation devices which shall be designed to prevent the discharge of untreated or inadequately treated sewage into navigable waters.

The Coast Guard shall promulgate regulations governing the design, construction, installation, and operation of any marine sanitation devices.

Initial standards and regulations become effective for new vessels two years after promulgation and for existing vessels five years after promulgation.

Before the standards and regulations are promulgated everybody interested including Federal and State Agencies and private industries have to be consulted by the Secretary of the Interior and the Secretary of Transportation.

After the effective date of the standards and regulations, no State or political subdivision can adopt or enforce any law or regulation respecting these devices in connection with any vessel covered by this law. The State can however prohibit discharge of sewage in any waters of the State where it is needed to implement water quality standards, with the approval of the Secretary of the Interior.

Existing vessels that have devices installed according to State statutes or the PHS "Handbook on Sanitation and Vessel Construction 1965" will be considered in compliance until they need replacement or are found not to be in compliance.

Existing State laws will govern where they require compliance prior to the Federal compliance date. Present State statutes which do not require waste disposal devices on watercraft or have a compliance date later than Federal law will be required to follow the Federal law concerning waste disposal devices and time schedule.

MR. GAMET: That is the end of the statement.

MR. STEIN: Thank you.

If there are no questions on that, we will go on. We from here on out will call upon the State agencies to make presentations and the States will be responsible for managing their own time.

First we will call on Wisconsin.

THOMAS G. FRANGOS, ADMINISTRATOR
DIVISION OF ENVIRONMENTAL PROTECTION
WISCONSIN DEPARTMENT OF NATURAL RESOURCES
MADISON, WISCONSIN

MR. FRANGOS: Mr. Chairman, conferees.

My name is Thomas Frangos, the Wisconsin Department of Natural Resources, and I will present information to you on the Wisconsin program relating to recommendations of this enforcement conference. I believe that all the conferees have a copy of this report and I request that the full report be made part of the record.

MR. STEIN: Without objection, the entire report will be entered into the record as if read.

(Which said report is as follows:)

WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Division of Environmental Protection

PROGRESS REPORT

to the

LAKE SUPERIOR ENFORCEMENT CONFERENCE

Duluth, Minnesota
April 29-30, 1970

The following is a summary report of Wisconsin actions and programs related to achieving compliance with the recommendations of the first session of the Conference. Comments have been itemized to correspond with the recommendation number as they appear in the Summary of Conference issued by the Secretary of the Interior, January 26, 1970.

Recommendation No. 1 - Technical Committee

Two staff members participated in the development of the report "Water Quality Guidelines for Lake Superior" which was prepared by the Lake Superior Water Quality Technical Committee. Wisconsin is in substantial agreement with the recommendations contained in that report.

Recommendations No. 2 and No. 3 - Reserve Mining

Recommendation No. 4 - Water Quality Surveillance Program

Monitoring stations were established in 1961 on the Montreal River and the Bad River, and a new station was established in 1969 at the City of Ashland water intake. Samples are collected monthly with determinations made for alkalinity, chlorides, hardness, color, pH, 5-day BOD, solids, fecal coliforms, temperature and dissolved oxygen. In addition, nutrients are determined on a quarterly basis.

Recommendation No. 5 - Secondary Biological Waste Treatment

In keeping with the State Stream Standards and to provide for and enhance the uses of our watercourses, it has been determined that the minimum treatment for domestic sewage should be equivalent to that normally referred to as secondary treatment. It is further required that all plants treating domestic or industrial wastes which discharge effluent to surface waters be under the direction of a certified operator.

Recommendations No. 6 and No. 7 - Disinfection

Wisconsin endorses the continuous disinfection of municipal treatment plant effluents and those industrial discharges containing pathogenic bacteria which may have a deleterious effect on persons coming into contact with Lake Superior water. It is our statewide policy that throughout the year all bio-mechanical municipal treatment facilities must provide continuous disinfection. All Wisconsin municipalities affecting Lake Superior are in compliance with this recommendation.

Recommendation No. 8 - General Waste Treatment Requirements

This recommendation pertains to treatment of municipal wastes and calls for an 80 percent overall removal of phosphorus in each states' portion of the Lake Superior drainage basin.

The Wisconsin Natural Resources Board, at its April 1969 meeting, adopted a policy on phosphorus removal (appended as Attachment B). On the basis of this policy and the recommendation of the Conference, Wisconsin is requiring greater than 80 percent removals by the 3 municipalities containing populations of 2,500 or more to attain the overall objectives. There are 8 sewered municipalities in the Lake Superior basin of which 3 account for nearly 90 percent of the population.

Recommendation No. 9 - Industrial Wastes

All industries located within the basin shall meet requirements of the approved Wisconsin interstate water quality standards, as well as the intrastate standards now in effect. Industries are being encouraged to cooperate with municipalities in providing joint treatment facilities where technically feasible and economically desirable.

Recommendation No. 10 - Abatement Schedules

In accordance with the recommendations of the Lake Superior Enforcement Conference, a list of municipalities and industries discharging wastewaters to the Lake Superior basin is submitted to the conferees and is shown in Attachment A.

Wisconsin's Statutes and administrative practices call for periodic drainage basin or sub-basin surveys, report of findings, public hearings and finally issuance of orders to those pollution sources where corrective measures need to be taken.

In 1968, orders were issued to Wisconsin sources of pollution in the Lake Superior drainage basin. The orders generally required the provision of adequate treatment facilities in keeping with the water quality standards. Since these orders were issued prior to the convening of the Lake Superior Conference, they do not fully implement all of the Conference recommendations. They do not require phosphorous removal. These orders do, however, require completion dates well in advance of the January 1974 requirements for secondary treatment established by this Conference.

The Department of Natural Resources has scheduled meetings with municipalities and industries to review status of compliance. These meetings, scheduled for May 1st in Ashland, are pre-enforcement conferences conducted jointly with the State Attorney General to evaluate progress that has been made under existing orders. Prior to June 1st, a formal hearing will be conducted to develop new or amended orders that will incorporate new requirements and compliance dates. Where necessary compliance dates may be extended. In no instance will completion dates extend beyond May 1972. This means that compliance will occur at least 20 months prior to the timetables established by this Conference.

The following is a narrative description of the status of each of Wisconsin's waste sources which affect or may affect the water quality of Lake Superior or interstate waters:

The City of Ashland was ordered to construct adequate sewage treatment facilities and to develop plans for storm and sanitary sewage separation or construct treatment facilities for both clear water and wastewater. Preliminary plans were submitted on March 31, 1969 and on February 23, 1970 a "Comprehensive Review on Water and Sewerage Systems" report was received. This new report furnishes information on the adequacy of the sanitary sewers and lift stations and the need for sewer extensions. Recommendations were made for the needed facilities and site locations.

The City of Bayfield was ordered to construct sewage treatment facilities and to develop a program for clear water exclusion or construct facilities for adequate treatment of both wastes and waters tributary to the system. The city retained a consulting engineer in June 1968, and during the summer of 1969 a survey was conducted on the existing sewage treatment plant.

The City of Hurley was ordered to construct adequate sewage treatment facilities and to develop a clear water exclusion program or to construct adequate treatment facilities for both clear water and wastes. Through legal conferences, the city has agreed to adopt a clear water exclusion ordinance, survey the existing clear water problems by July 1, 1970, submit a preliminary engineering report by August 1, 1970, submit final plans within 60 days after approval of the preliminary report, and complete the required construction by the end of the 1971 construction season.

The City of Superior was ordered to construct adequate waste treatment facilities and to develop a program for storm and sanitary sewer separation or construct facilities for adequate treatment of both wastes and waters tributary to the sewer system. A preliminary engineering report was submitted on March 6, 1969. A letter from the Department stated that a definite timetable for elimination of clear water and separation of combined sewers was needed. Also required were further flow figures, data on aeration units, feasibility of joint treatment with Superior Fiber Products, and phosphorus removal considerations.

The City of Washburn was ordered to construct adequate treatment facilities and to develop a program for clear water exclusion or provide for both clear water and waste treatment. The city retained a consulting engineer, and final plans and specifications for treatment facilities are being prepared.

The Pure Air Sanitorium was ordered to provide adequate treatment facilities. An engineer was retained, and a preliminary report has been submitted. With the existing small amount of wastewaters generated, the septic tank— soil absorption system currently in use may be adequate. The present waste flow is about 5,000 gallons per day, but consideration is being given to changing the institution to a home for the aged. Field checks by the district staff are pending.

Superior Fiber Products, Incorporated, was ordered to construct adequate process wastewater treatment facilities individually or jointly with the City of Superior. Also, sanitary sewage must be connected to the city sewerage system or receive adequate treatment. A preliminary engineering report will be submitted shortly as was agreed to by the company after conference with the state's attorneys. A joint treatment proposal with the city was rejected by Superior Fiber Products. Sanitary sewage will be dealt with following a sanitary survey of Superior's waterfront.

The American Can Company provides chemical treatment of process wastewaters. The facilities include chemical feeders, clarification and centrifuging which after installation satisfied the water pollution abatement order. Further treatment by biological methods may be required.

Bodin Fisheries, Incorporated, Bayfield, has directed all wastewaters to the city and, therefore, has complied with the water pollution abatement order as of April 1, 1970.

The Du Pont Company was ordered to provide adequate treatment of wastes. On June 1, 1969, they submitted an engineering report and final plans for facilities to dispose of their neutralized wastes by dispersion.

This January, after continued research, an alternate proposal was submitted for the evaporation and incineration of their wastes using newly developed techniques. Earlier this year, changes were instituted resulting in a 60 percent decrease in the pollution from this plant. However, an extension of time to May 1, 1972 is needed to place the evaporation--incineration facilities in operation.

Recommendations No. 11 and No. 12 - Areawide Sewerage Systems

The recommendations concerning the encouragement of unified collection systems for contiguous areas and fostering the replacement of malfunctioning septic tanks with adequate collection and treatment facilities were incorporated into a "Policy on Proliferation of Waste Treatment Plants." This policy reaffirms Wisconsin's position encouraging the joint treatment of municipal and industrial wastes. A copy of the May 1969 Board policy is appended as Attachment C.

Recommendation No. 13 - Bypassing

Municipalities having combined sewers in the Wisconsin portion of the Lake Superior drainage basin appear in the same list required for Recommendation No. 10. This is shown as Attachment A. Action is being taken to minimize bypassing whenever possible. All orders issued by the Department contain requirements for reducing bypassing from combined sewers or where "clear water" problems exist. Flow regulating devices may be effective in an overall program of reducing pollution from combined wastes.

Recommendation No. 14 - Combined Sewers

Combined sewered areas are being separated in relation to urban renewal projects and whenever reconstruction projects permit such separation. No new combined sewers are being installed.

The high cost of sewer separation in the cities makes it imparative that more practical methods of handling combined sewage be developed. Different techniques are being investigated at federal demonstration grant projects in the Cities of Chippewa Falls, Milwaukee and Kenosha.

Chippewa Falls is discharging high flows associated with storm water into a holding pond where the waste is stored until the flow subsides sufficiently to allow the pond contents to be directed to the treatment facility.

The City of Milwaukee installed a large tank which holds combined sewage for subsequent pumping to the interceptor sewers when the flow subsides. This facility is provided with chlorination equipment to allow primary sedimentation and disinfection of the combined sewage flow prior to discharge when the flow exceeds the capacity of the tank.

At Kenosha, it is proposed to develop an expandable treatment facility to cope with combined sewage flows by providing additional secondary treatment capacity. Plans have been approved and the city is proceeding on the project.

Provisions are made at the three demonstration projects to provide records of flow volumes and treatment achieved so that these systems can be appraised. None of the three projects in Wisconsin appear to be panaceas, yet each has merit and may provide a solution for certain situations and areas.

Recommendation No. 15 - Pesticides

Last year, Governor Knowles signed into law Chapter 146, Laws of 1969 (Attachment D), which pertained to the use and regulation of pesticides. The law establishes a Pesticide Review Board with representation from Health, Agriculture and Natural Resources. All rules regarding pesticides promulgated by any Wisconsin state agency are subject to revision and approval by the Pesticide Review Board.

Chapter 426, Laws of 1969 (Attachment E), was published on March 11, 1970. This law prohibits the distribution, sale and use of DDT except under certain limited conditions.

The Wisconsin Department of Natural Resources initiated a pesticide monitoring program in 1969 such that all streams tributary to Lake Superior have been sampled. In addition, water and plankton from Lake Superior open waters are being sampled for pesticide residue. It is anticipated that a report on the pesticide monitoring results will be published early in 1971.

The Department sponsored research projects and is currently cooperating with the FWQA in further studies to evaluate the impact of new pesticide control programs.

Recommendation No. 16 - Watercraft Pollution

Recent Wisconsin legislation (Attachment F) has extended the boat toilet law to include outlying waters of the state. This prohibits the operation of boats equipped with toilets on any outlying waters of the state unless the toilet wastes are retained for shore disposal. The new law does not apply to boats engaged in international or interstate commerce. Federal regulation is needed to control sewage pollution from the latter sources.

Wisconsin law applies to outlying waters with respect to prohibiting the throwing or depositing of trash, garbage, debris, litter, etc., into waters of the state and provides a fine of up to $200 for each offense. The total number of cases on outlying, inland and boundary waters amounted to 323 in 1968 compared with 175 in 1969.

Recommendation No. 17 - Dredging

This recommendation called for prohibition of the dumping of polluted material into Lake Superior.

On June 6, 1969, Governor Knowles, with the advice of an ad hoc committee, sent a position statement to the Corps of Engineers regarding Great Lakes spoil disposal. The Governor pointed out that more scientific research in this area is urgently needed to assess the impact of land disposal techniques on wetlands. Development of an equitable formula for financing is also needed. It was suggested that a long-range program be considered by the Great Lakes Basin Commission.

Recommendation No. 18 - Red Clay Interagency Committee

Report appended as Attachment G.

Recommendation No. 19 - Oil Pollution

All significant controllable discharges of oil to the Wisconsin section of Lake Superior have been eliminated.

Municipalities
April 28, 1970

WISCONSIN WASTEWATER SOURCE IN LAKE SUPERIOR DRAINAGE BASIN

Source (Order No.)	Receiving Waters	Existing Treatment	Remedial Needs	Affects L. Superior	Status
Ashland (1-68-2)	Lake Superior	Primary and Disinfection	Secondary Clear Water Phosphorus	Yes Yes Yes	Eng. retained & preliminary report submitted 3/69, 2/70. Planning ext. to 8/70.
Bayfield (1-68-4)	Lake Superior	Primary and Disinfection	Secondary Clear Water	Yes Yes	Eng. retained 6/68, 24 hr. STP survey, 1969.
Hurley (1-68-11)	Montreal River	Primary and Disinfection	Secondary Clearwater Phosphorus	Yes Yes Yes	Order extension on construction to 10/71 through legal staff requested.
Iron River (1-68-13)	Iron River	Primary	Secondary Clear Water	No No	Final plans for STP and sewer system almost complete 1/70. Resolution complete construction by 9/70.
Knight, Tn. of (Iron Belt) (1-68-12)	Iron Belt Trib.	Primary	Secondary Clear Water	No No	Plans submitted 6/69.
Mellen (1-68-15)	Bad River	Primary	Secondary Clear Water	No No	Legal conference 10/69.
Montreal (1-68-16)	W. Fork Montreal R.	Primary	Secondary Clear Water	No No	Legal conference 1/70. Agreement to complete construction 8/71.
Pence (1-68-20)	Pence Tributary	Septic Tanks	Adeq. Fac.	No	Public health problem. No stream pollution.
Saxon (1-68-23)	Vaughn Creek	Septic Tanks	Adeq. Fac.	No	" " "

Page 2
Municipalities
April 28, 1970

WISCONSIN WASTEWATER SOURCES LAKE SUPERIOR DRAINAGE BASIN

Source (Order No.)	Receiving Waters	Existing Treatment	Remedial Needs	Affects L. Superior	Status
Port Wing, Tn. of	Trib., Flag River	Lagoon	None	No	Treatment Satisfactory
Superior, City of	Lake Superior	Primary and Disinfection	Secondary Clear Water Phosphorus	Yes Yes Yes	Preliminary report 3/69. Letter of 3/70. Following conf. with staff, outlined additional information needed from cons. eng.
Superior, Vil. of	Pokegama River	Stabilization Pond	None	No	
Washburn (1-68-30)	Lake Superior	Primary and Disinfection	Secondary Clear Water	Yes Yes	Eng. retained 7/68. 24-hr. STP survey, 1969. Preliminary report 8/69. Requested final plans by 1/70.
Ondassagon School, Ashland (1-68-19)	Whittlesey Creek		Secondary	No	Legal extension to 1970. Plans approved 4/6/70.
Pure Air San.. Bayfield (1-68-21)	Drainage Course	Septic Tanks	Pending	No	Existing septic tanks to be checked for adequacy. Engineer retained 9/68.

Industries
April 28, 1970

WISCONSIN WASTEWATER SOURCES LAKE SUPERIOR DRAINAGE BASIN

Source (Order No.)	Receiving Waters	Existing Treatment	Remedial Needs	Affects L. Superior	Status
Twin Ports Dairy, Benoit (1-68-28)	S. Fork, Fish Cr.	None	Adequate Treatment	No	Constructed septic tank and dry well for san. sewage. Legal agreement to have complete compliance by 8/70.
Martin's Dairy, Cornucopia (1-68-14)	Siskiwit River	None	None	No	Ceased operations 3/69.
Fuhrmann's South Shore Dairy, Iron River (1-68-9)	None	Hauling	None	No	No discharge.
Great Northern R.R., Allouez (1-68-10)	Bluff Creek	None	Adequate Treatment	No	Plans submitted 3/69. Agreement to have complete compliance within 90 days of state plan approval.
Koppers, Inc., Superior	None	Lagoon		No	No discharge.
Murphy Oil Co., Superior (1-68-31)	Newton Creek	Separator & Lagoons	Adequate Treatment	No	Plans and specifications submitted 3/20/70.
Great Northern R.R., Superior	Drainage	Separator & Lagoons	None	No	No discharge.
Soo Line R.R., Superior (1-68-24)	Drainage	Connected to	None	No	No discharge.

WISCONSIN WASTEWATER SOURCES LAKE SUPERIOR DRAINAGE BASIN

Source (Order No.)	Receiving Waters	Existing Treatment	Remedial Needs	Affects L. Superior	Status
Union Tank Car, Superior (1-68-29)	Drainage	Septic Tank and Lagoons	None	No	No discharge.
Superior Fiber Products Company, Superior (1-68-26)	Lake Superior	Chemical and Screening	Sanitary Sew. Treatment, Ind. Waste Treatment	Yes	Joint treatment with city rejected 8/69. 120 tons/day hardboard mill. Legal requested preliminary eng. report for ind. waste 3/70. San. sewage will be dealt with pending Dept. investigations in spring of 1970.
Mason Milk Products, Mason	Drainage	Septic Tank and Lagoons	None	No	No discharge.
American Can Company, Ashland (1-68-3)	Lake Superior	Mechanical Clarifiers Centrifuge	None	Yes	Investigating sludge incineration. 2½ MGD, BOD 80-150 mg/1.
Lake Superior Power Co., Superior	Lake Superior	None	None	No	
Moquah Cheese Fcty., Moquah (1-68-17)		Hauling	None	No	Order satisfied 12/68.
Bodin Fisheries, Bayfield (1-68-5)	Lake Superior	Connected	None	No	Connection to city verified 3/12/70.

WISCONSIN WASTEWATER SOURCES LAKE SUPERIOR DRAINAGE BASIN

Source (Order No.)	Receiving Waters	Existing Treatment	Remedial Needs	Affects L. Superior	Status
E. I. DuPont Nemours Barksdale (1-68-7)	Boyds Creek	Neutralization Flow Equalization	Adequate Ind. Waste Treatment	Yes	Evaporation-incineration proposal pending approval. Time schedule dependent on approval.
Andersonville Coop. Dairy, Ashland (1-68-1)	Little Beartrap Creek	Holding and Hauling	None	No	No discharge pending field check.

Attachment B

State of Wisconsin
Department of Natural Resources

POLICY ON PHOSPHORUS REMOVAL FROM EFFLUENT
(Adopted April 17, 1969)

PREAMBLE

Phosphorus is a key nutrient controlling fertility of natural waters. Small concentrations of phosphorus may stimulate the growth of blue-green algae and other organisms, making rivers and lakes unsuitable for recreation and increasing water purification costs. Where algae do not thrive, increased growth of floating and bottom-rooted weeds impedes stream flow and complicates other aspects of water management.

Sewage effluents often contribute large amounts of phosphorus to surface waters. Methods exist for substantial removal of phosphorus from sewage and industrial wastes.

POLICY

Prompt action to reverse the present over-fertilization of waters of Wisconsin and to enhance the quality of these waters for all useful purposes is essential.

It is the policy of the Natural Resources Board that:

1. The Department of Natural Resources may require any waste-water discharger--regardless of population, volume or type of waste discharged, or geographic location--to provide for removal of excess amounts of phosphorus where such discharges are causing, or may cause, over-fertilization of surface waters.

2. In conformance with recommendations of the Lake Michigan Enforcement Conference, the Department shall take the actions necessary to achieve an overall reduction of at least 80 percent of the phosphorus tributary to municipal and industrial waste treatment facilities located within the Lake Michigan drainage basin by December 31, 1972.

State of Wisconsin
Department of Natural Resources
Attachment C

Policy on Proliferation of Waste Treatment Plants

To avoid costly errors through the construction of a multiplicity of waste treatment plants in conflict with area-wide or basin-wide concepts of pollution control, a clear declaration of policy is necessary.

It is the policy of the State of Wisconsin Natural Resources Board to:

1. Promote the use of unified sewage collection systems serving contiguous areas.
2. Encourage (in accordance with Section 144.07, Wisconsin Statutes) connection of developing areas to existing treatment plants wherever such action is fully feasible and clearly in the public interest.
3. Discourage construction of sewage treatment facilities not designed in accordance with an acceptable area-wide plan.
4. Discourage proliferation of small sewage treatment plants in contiguous areas and encourage abandonment of multiple plants in favor of joint treatment where technically feasible and economically desirable.
5. Disapprove use of state construction grant monies for construction of treatment plants not in conformity with an acceptable plan.
6. Encourage joint treatment of municipal and industrial wastes where physically and economically practical.
7. Disapprove installation of septic tank-soil absorption systems in areas where risk of malfunction or failure is high, and where alternate collection and treatment systems can be provided.
8. Promote replacement of nonfunctioning septic tanks with alternate collection and treatment systems to meet the intent of this policy.

Adopted: May 15, 1969

Attachment D

COPY

(No. 124, S.)

CHAPTER 146 LAWS OF 1969

AN ACT

AN ACT to amend 29.60 (5) (c); to repeal and recreate 29.29 (4); and to create 15.191 (2), 15.195, 94.69 (8), (9) and (10), 140.05 (15) and 140.77 of the statutes, relating to the use of pesticides, creating a pesticide review board, and granting rule-making power.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. 15.191 (2) of the statutes is created to read:

15.191 (2) PESTICIDE REVIEW BOARD. The pesticide review board shall have the program responsibilities specified under ss. 29.29 (4), 94.69 (9) and 140.77.

SECTION 2. 15.195 of the statutes is created to read:

15.195 SAME; ATTACHED BOARDS AND COMMISSIONS. (1) PESTICIDE REVIEW BOARD. There is created in the department of health and social services a pesticide review board. The review board shall consist of the secretary of agriculture, the secretary of natural resources and the secretary of health and social services or their designated representatives.

SECTION 3. 29.29 (4) of the statutes is repealed and recreated to read:

29.29 (4) USE OF PESTICIDES. The department of natural resources, after public hearing, may adopt rules governing the use of any pesticide which it finds is a serious hazard to wild animals other than those it is intended to control, and the making of reports thereon. In making such determinations, the department to the extent relevant shall consider the need for pesticides to protect the well-being of the general public. It shall obtain the recommendation of the pesticide review board and such rules are not effective until approved by the pesticide review board. "Pesticide" has the meaning designated in s. 94.67.

SECTION 4. 29.60 (5) (c) of the statutes is amended to read:

29.60 (5) (c) Nothing in this chapter shall prevent the ~~commission~~ *department* or its ~~deputies~~ *wardens* from using dynamite or having dynamite in possession near beaver houses or dams for the purpose of removing beaver dams when the beavers are causing damage to property owners, ~~nor shall it be unlawful for any person to use poisoned baits, dynamite or poison gas under rules and regulations which shall be prescribed jointly by the commission and the state department of agriculture, for the destruction of injurious insects, rodents or English sparrows~~. —

(over)

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SECTION 5. 94.69 (8), (9) and (10) of the statutes are created to read:

94.69 (8) To govern the conditions under which containers of pesticides may be transported, stored or disposed of.

(9) To govern the use of pesticides, including their formulations, and to determine the times and methods of application and other conditions of use.

(10) The department shall adopt rules when it determines that it is necessary for the protection of persons or property from serious pesticide hazards and that its enforcement is feasible and will substantially eliminate or reduce such hazards. In making such determination the department shall consider the toxicity, hazard, effectiveness and public need for the pesticides, and the availability of less toxic or less hazardous pesticides or other means of pest control. It shall obtain the recommendations of the pesticide review board and such rules are not effective until approved by the pesticide review board. Such rules shall not affect the application of any other statutes or rule adopted thereunder.

SECTION 6. 140.05 (15) of the statutes is created to read:

140.05 (15) Where the use of any pesticide results in a threat to the public health, the department of health and social services shall take all measures necessary to prevent morbidity or mortality.

SECTION 7. 140.77 of the statutes is created to read:

140.77 PESTICIDE REVIEW BOARD. (1) The pesticide review board created by s. 15.195 shall collect, analyze and interpret information, and make recommendations to and coordinate the regulatory and informational responsibilities to the state agencies, on matters relating to the use of pesticides, particularly recommendations for limiting pesticide use to those materials and amounts thereof found necessary and effective in the control of pests and which are not unduly hazardous to man, animals or plants. Pesticide rules authorized by ss. 29.29 (4) and 94.69 are not effective until approved by the review board.

(2) The pesticide review board shall appoint a council not to exceed 6 members of technical or professional experts composed of one representative each from the department of agriculture, department of health and social services, department of natural resources, college of agricultural and life sciences of the university of Wisconsin, water resources center of the university of Wisconsin, school of natural resources of the university of Wisconsin, and in addition 3 public members appointed by the governor and confirmed by the senate for staggered 3-year terms who shall be technical or professional experts in the use of pesticides, one of whom shall be a representative of the pesticide industry, one of whom shall be a representative of the agricultural industry and one of whom shall be a person of broad knowledge and experience in the conservation and wise use of natural resources. The council shall generally assist the review board and shall assist particularly in obtaining scientific data and coordinating pesticide regulatory, enforcement, research and educational functions of the state.

(3) The pesticide review board shall report to the governor and the legislature any pesticide matters it finds are of vital concern for the protection of the health and well-being of people or for the protection of fish, wildlife, plants, soil, air and water from pesticide pollution. Such report may include its recommendations for legislative or other governmental action.

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Attachment E

(No. 163, A.)

CHAPTER 426 LAWS OF 1969

AN ACT

AN ACT to create 134.67 of the statutes, prohibiting the distribution, sale and use of the chemical compound DDT.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. 134.67 of the statutes is created to read:

134.67 DISTRIBUTION AND SALE OF DDT PROHIBITED. No person shall distribute, sell, offer for sale or use the chemical compound DDT (dichlorodiphenyltrichlorenthane) or any of its isomers except as provided in this section. In subs. (1) and (2) "DDT" includes compounds isomeric with DDT.

(1) For the purposes specified in sub. (2), the secretary of agriculture, the state health officer and the secretary of natural resources shall constitute a DDT emergency board, and any such officer may call a meeting of the emergency board to act under sub. (2).

(2) (a) In the event of the outbreak of an epidemic disease of humans or animals spread by insects which it is known can be controlled by DDT but cannot be adequately controlled by any other known pesticide, the emergency board may authorize the use of DDT in controlling the epidemic upon a finding that:

1. A serious epidemic disease of humans or animals exists;

2. The disease is likely to spread rapidly unless insects which spread the disease are controlled; and

3. The only effective means of control is DDT.

(b) In the event of the outbreak of a plant disease of epidemic proportions which threatens a significant portion of the affected crop and which is caused or spread by an insect which it is known can be controlled by DDT but cannot be adequately controlled by any other known pesticide, the emergency board may authorize the use of DDT in controlling the epidemic upon a finding that:

1. An epidemic plant disease exists;

2. The disease threatens a significant portion of the affected crop; and

3. The only effective means of control is DDT.

(c) The emergency board also may authorize the use of DDT or its isomers or metabolites for specified research by educational institutions if it finds that no ecologically significant residues of DDT or its isomers or metabolites will be allowed to escape into the environment.

(over)

SECTION 2. *RECONCILIATION WITH PENDING LEGISLATION.* If Senate Bill 124 which creates a pesticide review board becomes law, section 134.67 (1) of the statutes, as created by this act, is repealed and references in section 134.67 (2) of the statutes, as created by this act, to the "emergency board" shall be deleted and references to "pesticide review board" substituted therefor.

SECTION 3. *EFFECTIVE DATE.* This act shall take effect on December 31, 1969, or on the day after publication, whichever occurs later.

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3–69

Attachment F

STATE OF WISCONSIN

1969 Assembly Bill 417 Date published*: March 19, 1970

CHAPTER 471 , LAWS OF 1969

AN ACT to amend 30.71 (1); and to repeal and recreate 30.71 (2) of the statutes, relating to use of boat toilets on outlying waters of the state.

The people of the state of Wisconsin, represented in senate and assembly, do enact as follows:

SECTION 1. 30.71 (1) of the statutes is amended to read:

30.71 (1) No person shall operate any boat equipped with toilets on inland waters of this state~~, except the Mississippi river,~~ unless the toilet wastes are retained for shore disposal by means of facilities constructed and operated in accordance with rules adopted by the state board of health. "Inland waters" means the waters defined as inland waters by s. 29.01 (4).

SECTION 2. 30.71 (2) of the statutes is repealed and recreated to read:

30.71 (2) No person shall operate any boat equipped with toilets on any outlying waters of this state, as defined in s. 29.01 (4), unless the toilet wastes are retained for shore disposal by means of facilities constructed and operated in accordance with rules adopted by the department of health and social services. This subsection shall not apply to boats engaged in international or interstate commerce.

SECTION 3. EFFECTIVE DATES. SECTION 1 of this act shall take effect on January 1, 1971. SECTION 2 of this act shall take effect on January 1, 1970.

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*Section 990.05. *Wisconsin Statutes*: Laws and acts; time of going into force. "Every law or act which does not expressly prescribe the time it takes effect shall take effect on the day after its publication."

Attachment G

RED CLAY INTERAGENCY COMMITTEE ACTIVITIES

In 1955, representatives of agencies concerned with land use problems on the red clay soils of northwestern Wisconsin met to analyze the conditions existing in the area. In 1956, the directors of these agencies designated representatives to serve on a Red Clay Interagency Committee. This committee, together with the assistance of field personnel from their respective organizations, local landowners and interested people, evaluated land use problems on red clay soils and prepared and distributed a report on the Whittlesey Watershed (May 1957) which contained a description of the problems and proposals to correct them.

The Whittlesey Watershed was selected for intensive study. From 1958 to the end of 1959, a considerable amount of work was done as a follow-up on the recommendations contained in the May 1957 Whittlesey Watershed report by the Red Clay Interagency Committee. The 1960 progress report contained a brief presentation on the established practices, experiments conducted and the results obtained during the period of 1958-60.

The 1964 progress report covers the period from April 1960 to December 1963. In addition to the results of the demonstrations, this report contained some specific recommendations on the establishment of protective cover on stream banks and highway banks to protect them against loss of topsoil and eventual stream and lake siltation.

In 1967, this committee temporarily concluded its work by submitting a report consisting of recommendations and a summary of development and research results to serve as a guide to all organizations concerned with the control of erosion and sedimentation in the area. This report was entitled "Erosion and

Sedimentation Control on the Red Clay Soils of Northwestern Wisconsin." Copies of this report have been distributed to conferees of the Conference to supply information on the action plan developed by the Red Clay Interagency Committee. During the last two years this committee has been rather inactive, but it is understood that the topic will be reviewed in 1970 to ascertain what has been done towards the implementation of the 1967 recommendations.

In order to implement the recommendations contained in the committee's final report, the Water and Land Subcommittee of the Natural Resources Committee of State Agencies prepared an action type of report which was entitled "Report on Surface Drainage of Lake Superior Watershed" (September, 1967). In addition to a description of these watersheds and an outline of surface drainage and related problems, this report contained a presentation of possible solutions to problems as well as a consideration of present comprehensive programs. Although efforts are continually being made to handle some of the more serious situations, complete control of the matter would seem beyond the economic means of the area. An example to the point is that on one occasion it was estimated to cost well over one-half a million dollars to control the erosion of one and one-half miles of shoreline. Thus, it can be said that the control of sedimentation through improved soil and water management, improved highway construction and maintenance is a social, economic and political problem.

The Whittlesey Watershed in Bayfield County was selected by the committee for intensive evaluation because of local interest, the existence of a watershed association, and the availability of considerable information on the land problems of this particular area. The results obtained here were used for setting standards and developing procedures to be used in preparing a land management plan for the entire northwestern Wisconsin red clay area.

The Whittlesey Watershed is a geologically young area with soil erosion processes still occurring naturally at a rapid rate. These became accelerated wherever and whenever steep slopes become almost devoid of or bear only sparse stands of vegetation. Abnormally heavy rains have periodically accelerated erosion on exposed clay soils. Man has also speeded up erosion through certain agricultural activities, timber cutting and highway construction. These activities include primarily: (1) Forest fires and clear-cutting of stands, (2) grazing streambanks, and (3) construction of roads on or through erodable sites creating raw banks.

Although erosion and the resultant sedimentation cannot be eliminated entirely, they can be reduced through proper soil and water conservation practices. Generally, the presence of vegetation on steep slopes is one of the principal soil stabilizing factors. Vegetation serves to reduce runoff both by its use of water in growth processes and by physical retardation. However, there is reason to believe that cover alone will not in many cases stabilize the steep raw slopes, but nevertheless the maintenance of existing cover and the restoration of cover on denuded areas is the first course of action. Another method for controlling flooding and the resultant erosion and sedimentation would be to construct detention dams and sedimentation basins in the streambeds, providing that funds are available and that the benefits received will have sufficient value to warrant the expenditures.

The general objectives of the committee were:

1. Analyze land use problems on red clay soils and prepare a plan acceptable to all agencies from demonstrations in the Whittlesey Watershed and other watersheds, such as Elk Creek, MacKenzie Creek, Brule River, Track Creek, etc.

2. Develop specifications for developing and preparing road and streambanks for seeding, seed mixtures, and methods of seeding.

3. Assist local landowners with the fencing out of livestock to eliminate grazing on stream and roadbanks, shorelines and forests.

4. Promote sound forest management practices.

5. Demonstrate the use of various seed mixtures, various types of mulches with or without asphalt along with newly developed equipment such as the Finn hydroseeder and mulcher, International Paper "Twifiber," the Ludlow "soil-saver," etc., to establish cover for stabilizing steep inclines along streams, roads, shorelines, etc.

6. Establish ponds to lessen the effects of floods by withholding water during periods of high rainfall.

7. Stabilizing the shorelines of streams and lakes by cement bagging, willow planting, the use of "Gabions," etc., to prevent erosion and also flooding by deepening and straightening stream channels.

T. G. Frangos

MR. FRANGOS: The following is a summary report of Wisconsin actions and programs related to achieving compliance with the recommendations of the first session of the conference. Comments have been itemized to correspond with the recommendation number as they appear in the Summary of Conference issued by the Secretary of the Interior on January 26, 1970.

Recommendation No. 1. Technical Committee.

This was reported by the representative of that committee earlier in this conference. Wisconsin staff people participated in that committee, as you heard, and we are in substantial agreement with the recommendations contained in that report.

Recommendations Nos. 2 and 3 refer to Reserve Mining and we have no comments at this time.

Recommendation No. 4, water quality surveillance program.

Monitoring stations were established in 1961 on the Montreal River and the Bad River, and a new station was established in 1969 at the city of Ashland water intake. Samples are collected monthly with determinations made for alkalinity, chlorides, hardness, color, pH, 5-day BOD, solids, fecal coliforms, temperature and dissolved oxygen. In addition, nutrients are determined on a quarterly basis.

Recommendation No. 5, secondary biological waste treatment.

In keeping with the State Stream Standards and to provide for and enhance the uses of our watercourses, it has been determined that the minimum treatment for domestic sewage should be equivalent to that normally referred to as secondary treatment. It is further required that all plants treatment domestic or industrial wastes which discharge effluent to surface waters be under the direction of a certified operator.

Recommendations No. 6 and No. 7 refer to disinfection.

Wisconsin endorses the continuous disinfection of municipal treatment plant effluents and those industrial discharges containing pathogenic bacteria which may have a deleterious effect on persons coming into contact with Lake Superior water. It is our statewide policy that throughout the year all bio-mechanical municipal treatment facilities must provide continuous disinfection.

All Wisconsin municipalities affecting Lake Superior are in compliance with this recommendation.

Recommendation No. 8 refers to general waste treatment requirements.

This recommendation pertains to treatment of municipal wastes and calls for an 80 percent overall removal of phosphorus in each State's portion of the Lake Superior drainage basin.

The Wisconsin Natural Resources Board, at its April 1969 meeting, adopted a policy on phosphorus removal and that policy statement is appended to our report as Attachment B. On the basis of this policy and the recommendation of the conference, Wisconsin is requiring greater than 80 percent removals by the three municipalities containing populations of 2,500 or more to attain these overall objectives. There are eight sewered municipalities in the Lake Superior Basin, of which three account for nearly 90 percent of the population.

Recommendation No. 9, industrial wastes.

All industries located within the basin shall meet requirements of the approved Wisconsin interstate water quality standards, as well as the intrastate standards now in effect. Industries are being encouraged to cooperate with municipalities in providing joint treatment facilities where technically feasible and economically desirable.

Recommendation No. 10, abatement schedules.

In accordance with the recommendations of the Lake Superior enforcement conference, a list of municipalities and industries discharging wastewaters to the Lake Superior Basin is submitted to the conferees and is shown in Attachment A.

Wisconsin's statutes and administrative practices call for periodic drainage basin or sub-basin surveys, report of findings, public hearings and finally issuance of orders to those pollution sources where corrective measures need to be taken.

In 1968, orders were issued to Wisconsin sources of pollution in the Lake Superior drainage basin. The orders generally required the provision of adequate treatment facilities in keeping with the water quality standards. Since these orders were issued prior to the convening of the Lake Superior conference, they do not fully implement all of the conference recommendations. For example, they do not require phosphorus removal. These orders do, however, require completion dates well in advance of the January 1974 requirements for secondary treatment established by this conference.

The Department of Natural Resources has scheduled meetings with municipalities and industries to review status of compliance. These meetings, scheduled for May 1 in Ashland, are pre-enforcement conferences conducted jointly with the State Attorney General to evaluate progress that has been made under existing orders. Prior to June 1, a formal hearing will be conducted to develop new or amended orders that will incorporate new requirements and compliance dates. That date is April 21, and it will be held in Superior, Wisconsin. Where necessary, compliance dates may be extended. In no instance will completion dates extend beyond May 1972. This means that compliance will occur at least 20 months prior to the timetables established by this conference.

The following is a narrative description of the status of each of Wisconsin's waste sources which affect or may affect the water quality of Lake Superior or interstate waters:

The city of Ashland was ordered to construct adequate sewage treatment facilities and to develop plans for storm and sanitary sewage separation or construct treatment facilities for both clear water and wastewater. Preliminary plans were submitted on March 31, 1969, and on February 23, 1970, a "Comprehensive Review on Water and Sewerage Systems" report was received. This new report furnishes information on the adequacy of the sanitary sewers and lift stations and the need for sewer extensions. Recommendations were made for the needed facilities and site locations.

The city of Bayfield was ordered to construct sewage treatment facilities and to develop a program for clear water exclusion or construct facilities for adequate treatment of both wastes and waters tributary to the system. The city survey was conducted on the existing sewage treatment plant.

The city of Hurley was ordered to construct adequate sewage treatment facilities and to develop a clear water exclusion program or to construct adequate treatment facilities for both clear water and wastes. Through legal conferences, the city has agreed to adopt a clear water exclusion ordinance, survey the existing clear water problems by July 1, 1970, submit a preliminary engineering report by August 1, 1970. Final plans must be submitted within 60 days after approval of the preliminary report and the construction must be completed by the end of the 1971 construction season.

The city of Superior was ordered to construct adequate waste treatment facilities and to develop a program for storm and sanitary sewer separation or construct facilities for adequate treatment of both wastes and waters tributary to the sewer system. A preliminary engineering report was submitted in March of 1969. A letter from the Department stated that a definite timetable for elimination of clear water and separation of combined sewers was needed. Also required were further flow figures, data on aeration units, feasibility of joint treatment with Superior Fiber Products, and phosphorus removal considerations.

The city of Washburn was ordered to construct adequate treatment facilities and to develop a program for clear water exclusion or provide for both clear water and waste treatment. The city has retained a consulting engineer and final plans and specifications for treatment facilities are being prepared.

The Pure Air Sanitorium was ordered to provide adequate treatment facilities. An engineer was retained, and a preliminary report has been submitted. With the existing small amount of wastewaters generated, the septic tank-soil absorption system currently in use may be adequate. The present waste flow is about 5,000 gallons per day, but consideration is being given to changing the institution to a home for the aged. Field checks by the district staff are pending.

Superior Fiber Products, Incorporated, was ordered to construct adequate process wastewater treatment facilities individually or jointly with the city of Superior. Also, sanitary sewage must be connected to the city sewerage system or receive adequate treatment. A preliminary engineering report will be submitted shortly as agreed to by the company after conference with the State's attorneys. A joint treatment proposal with the city has been rejected by Superior Fiber Products. Sanitary sewage will be dealt with following a sanitary survey of Superior's waterfront, which is now under way.

T. G. Frangos

The American Can Company provides chemical treatment of process wastewaters. The facilities include chemical feeders, clarification and centrifuging which after installation satisfied the water pollution abatement order. Further treatment by biological methods may be required and the performance at that treatment facility is now being evaluated.

Bodin Fisheries, Incorporated, in Bayfield, has directed all wastewaters to the city and, therefore, has complied with the order as of April 1, 1970.

The Du Pont Company was ordered to provide adequate treatment of wastes. On June 1, 1969, they submitted an engineering report and final plans for facilities to dispose of their neutralized wastes by dispersion.

This January, after continued research, an alternate proposal was submitted for the evaporation and incineration of their wastes using newly developed techniques. Earlier this year, changes were instituted resulting in a 60 percent decrease in the pollution from this plant. However, an extension of time to May 1, 1972, is needed to place the evaporation-incineration facilities in operation.

At this time, Mr. Stein, I would like to read into the record a letter addressed to you concerning the Du Pont situation.

MR. STEIN: All right.

MR. FRANGOS: This letter is addressed to "Mr. Murray Stein, Chairman, Lake Superior Enforcement Conference, Federal Water Quality Administration, 633 Indiana Avenue N. W., Washington, D. C.

"Dear Mr. Stein:"

MR. STEIN: Mr. Frangos, may I go off the record for just a moment?

MR. FRANGOS: Yes.

(Off the record.)

MR. STEIN: Let's go back on the record.

(Which said letter follows:)

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

L. P. Voigt
Secretary

BOX 450
MADISON, WISCONSIN 53701

April 28, 1970

Mr. Murray Stein, Chairman
Lake Superior Enforcement Conference
Federal Water Quality Administration
633 Indiana Avenue, N. W.
Washington, D. C. 20242

Dear Mr. Stein:

The E. I. Du Pont de Nemours & Company owns and operates a TNT plant at Barksdale, Wisconsin. After neutralization and flow equalization, wastes from these operations discharge to Boyds Creek and flow into Chequamegon Bay. About 15 years ago the Company installed land disposal facilities. These proved to be inadequate.

As part of the Wisconsin plan for implementation of the Interstate Water Quality Standards, we advised that "adequate treatment or disposal" of these wastes would be provided by October, 1970. In September, 1967 Du Pont officials met with representatives of this Department to discuss proposed remedial facilities. They pointed out that test results from several laboratories and years of experience demonstrated that the waste is harmless to humans, animals and aquatic life in the Bay and exhibits no oxygen demand. The problem is essentially one of aesthetics caused by color. Methods of handling these wastes at several federal installations have not been very satisfactory.

The 1967 proposal was reviewed by staff of our Department and with Federal Water Pollution Control Administration personnel. On the basis of these discussions and the Company presentation to the Natural Resources Board, the Natural Resources Board advised that it would not be opposed to disposal of wastes by dispersion. A final decision on the acceptability of this method of disposal was left open, pending the development of technical data by the Du Pont Company. The Du Pont Company prepared an engineering report and final plans for the disposal facilities were submitted to the Department on June 1, 1969. In the interim period, some reservations developed and these plans have not been approved by the Department of Natural Resources.

Additional meetings with the Federal Water Quality Administration followed last fall and winter. Recent research investigations by Du Pont indicate that a new process of evaporation-incineration, using newly developed techniques and a fluidized bed incinerator, will permit the burning of wastes without the inherent disadvantages of prior processes. Du Pont has now proposed to our Department that it use the latter alternate approach. The Company has further proposed a revised time schedule as follows:

1. Submissions of plans and specifications - 3 months after permission to proceed.

2. Fabrication of equipment and complete construction - 18 months after final approval of plans and specifications by this Department.

Considering a period for state technical review and approval, the overall date for completion of the project would be May 1, 1972, with interim dates of August 1, 1970 for submission of plans and December 1, 1970 for the beginning of construction.

As an interim measure, the Company has initiated internal changes in operations that have resulted in a 60 percent reduction in the concentration of the waste discharge. The volume of discharge continues at about the previous level but concentrations have been reduced by that amount.

Although the new proposal has not been used elsewhere, we believe it has real potential. Successful development could be helpful in providing technology to improve handling of TNT wastes at other operations in the country. The time schedule now being considered is beyond that initially required. It significantly precedes deadlines recommended by the Conference. We believe it should provide a more acceptable solution of the problem.

Early concurrence in this proposal by the Federal Water Quality Administration is required so that the Company may proceed to initiate its abatement program.

Very truly yours,
Division of Environmental Protection

Thomas G. Frangos
Administrator

cc: Ralph W. Purdy
John P. Badalich
Francis T. Mayo
E. I. Du Pont de Nemours & Company

MR. STEIN: Thank you.

I wonder if I might interject there, it would help me considerably in responding to this request if before this session of the conference were completed I could get the views of the other States as well on the proposed extension of the time, and whenever you feel appropriate we could have those comments.

MR. FRANGOS: All right, fine.

As you know, this has been a difficult technical situation and it seems to us that this offers a real good solution to the problem that they have up there. This will essentially, as far as treatment goes, be a closed system.

Recommendations Nos. 11 and 12, areawide sewerage systems.

The recommendations concerning the encouragement of unified collection system for contiguous areas and fostering the replacement of malfunctioning septic tanks with adequate collection and treatment facilities were incorporated into a "Policy on Proliferation of Waste Treatment Plants." This policy reaffirms Wisconsin's position encouraging the joint treatment of municipal and industrial wastes. We have attached a copy of the May 1969 Board policy on areawide sewerage systems.

Recommendation No. 13.

Municipalities having combined sewers in the Wisconsin portion of the Lake Superior drainage basin appear in the same list required for Recommendation No. 10. This is shown as Attachment A. Action is being taken to minimize bypassing whenever possible. All orders issued by the Department contain requirements, as we have indicated, for reducing bypassing from combined sewers or where "clear water" problems exist. Flow regulating devices may be effective in an overall program of reducing pollution from combined wastes.

Recommendation No. 14.

Combined sewered areas are being separated in relation to urban renewal projects and whenever reconstruction projects permit such separation. No new combined sewers are being installed.

The high cost of sewer separation in the cities makes it imperative that more practical methods of handling combined sewage be developed. Different techniques are being investigated at Federal demonstration grant projects in the cities of Chippewa Falls, Milwaukee and

Kenosha. Then the report recites very briefly the nature of these projects, but I won't take the time to read those now.

Recommendation No. 15 relates to pesticides.

Last year Governor Knowles signed into law Chapter 146, Laws of 1969, which pertained to the use and regulation of pesticides. The law establishes a Pesticide Review Board with representation from Health, Agriculture and Natural Resources. All rules regarding pesticides promulgated by any Wisconsin State agency are subject to revision and approval by the Pesticide Review Board.

Chapter 426, Laws of 1969, which appears as Attachment E, was published on March 11, 1970. This law prohibits the distribution, sale or use of DDT except under very limited conditions.

The Wisconsin Department of Natural Resources initiated a pesticide monitoring program in 1969 such that all streams tributary to Lake Superior have been sampled. In addition, water and plankton from Lake Superior open waters are being sampled for pesticide residue. It is anticipated that a report on the pesticide monitoring results will be published early in 1971.

The Department sponsored research projects and is currently cooperating with the FWQA in further studies to evaluate the impact of new pesticide control programs.

Recommendation No. 16, watercraft pollution.

Recent Wisconsin legislation (Attachment F) has extended the boat toilet law to include outlying waters of the State. This prohibits the operation of boats equipped with toilets on any outlying waters of the State unless the toilet wastes are retained for shore disposal. The new law does not apply to boats engaged in international or interstate commerce. Federal regulation is needed to control sewage pollution from the latter sources. And as indicated, we now have that.

Wisconsin law applies to outlying waters with respect to prohibiting the throwing or depositing of trash, garbage, debris, litter, etc., into waters of the State and provides a fine of up to $200 for each offense. The total number of cases on outlying, inland and boundary waters amounted to 323 in 1968 compared with 175 in 1969.

Recommendation No. 17.

This recommendation called for prohibition of the dumping of polluted material into Lake Superior.

On June 6, 1969, Governor Knowles, with the advice of an ad hoc committee, sent a position statement to the Corps of Engineers regarding Great Lakes spoil disposal. The Governor pointed out that more scientific research in this area is urgently needed to assess the impact of land disposal techniques on wetlands. Development of an equitable formula for financing is also needed. It was suggested that a long-range program be considered by the Great Lakes Basin Commission.

Recommendation No. 18, Red Clay Interagency Committee.

In response to a request by the previous session of this conference our Department has prepared a summary report which discusses our experience with erosion problems in the drainage basin and some of the work of the Red Clay Committee and followup work to the Red Clay Interagency Committee report. We have included that as Attachment G and this is included in the material that you have. If you so desire, we can read this. I will leave that to your discretion and the conferees' discretion.

Recommendation No. 19, oil pollution.

All significant controllable discharges of oil to the Wisconsin section of Lake Superior have been eliminated.

This concludes our report, Mr. Chairman and conferees, subject to your desire on our report on erosion problems.

MR. MACKIE: Mr. Chairman.

MR. STEIN: Yes.

MR. MACKIE: Before we get into specific questions, it might be worthwhile for both the conferees and for the audience to have a little broader explanation, perhaps, of the forthcoming conferences that Mr. Frangos spoke of a moment ago.

About 10 months ago the Department of Natural Resources entered into a memorandum of understanding with the State Attorney General which set up procedures for enforcement. Briefly this memorandum called for the institution of pre-enforcement conferences. In other words, when the polluter reaches the point where he is in some way delinquent as far as the orders are concerned, rather than referring it directly to the Attorney General at that time the memorandum of understanding calls for a pre-enforcement conference at which the polluter is called in and a conference is held with the polluter, representatives of our Department, the engineers, and a representative of the Attorney General. This conference really amounts to the polluter's last opportunity to explain his position and to explain his actions before going to court action.

It has turned out that this has been a very, very useful tool, and since the signing of this memorandum of understanding about 104 of these conferences have been held. And as I indicated, when the polluter is faced with the last opportunity before litigation, he usually comes to terms.

And of these 104--these don't all relate, of course, to Lake Superior--of these 104 only 6 of these were determined to be necessary to go to the Attorney General for prosecution. Some of the later ones are still in the early stages, but about 20 of them have been completely satisfied.

Of the six that I referred to, one of them has since complied, his plans are in. About three of them have been referred to the Attorney General and the balance now are in process of going to the Attorney General.

In relation to the meetings that are coming up within the next month, eight municipalities and three industries in the Lake Superior Basin are being called in to pre-enforcement conferences on the 1st of May. These will be followed by regular formal public hearings late in May.

As I recall, Tom, that is the 21st of May, is that right?

MR. FRANGOS: Yes, May. I think I said April. It should have been May.

MR. MACKIE: That is when the formal hearings will be held, but they will be preceded by pre-enforcement conferences with the Attorney General.

I thought it might be of interest, Mr. Chairman, for the conferees and the audience to know how we are proceeding along these lines.

MR. STEIN: That is a very helpful contribution. We all recognize that Wisconsin is in the forefront of pollution control as are the other States here, and in a sense it is interesting to see how much the Federal procedures and this procedure you have developed have paralleled each other, because we find that to be very effective too. We are doing about the same thing. So I think this is very encouraging.

Are there any comments or questions on the report? And I would like comments particularly on that proposal of the TNT plant.

Mr. Purdy.

MR. PURDY: Yes, Mr. Chairman.

Mr. Frangos, on the city of Hurley, you said it was ordered to construct adequate sewage treatment facilities and to develop a clear-water-exclusion program. I am not clear, down in the lower part on the submission of preliminary engineering report by August 1970 and then to have the required construction done by 1971. Is that referring only to the clear-water part or to the--

MR. FRANGOS: No, this refers to the total program. I might add that they are now disinfecting year-round, so that that has been-- But this applies to the total program.

MR. PURDY: I also might make a comment with respect to the Du Pont problem and the way that I would look at it. Since the company has proposed an interim measure that has resulted in a 60 percent reduction in the concentration of the wastes, there have been some immediate improvements and the alternate treatment process now proposes a closed system, that is it will offer much more than the initial dilution project, it would seem to me that the new proposal now represents something that I feel would be desirable and the time schedule proposed would appear initially to be reasonable.

I also have a question with respect to the Red Clay recommendations, Mr. Frangos. Have they been implemented? What has happened since the report was submitted?

MR. FRANGOS: Well, I would say that the implementation really hasn't progressed very far. I think the situation summarized would be we know the nature of the problem and the question is to marshal the resources, to do something about it. I think we touched on that a little bit yesterday with the discussion with the USDA people.

I would point out a section. We have done some further studies and some of the local districts are getting down to more specific projects on the cost, but this is a very expensive proposition.

For example, in one area we have got an estimate on a project that would cost about $1/2 million to control the erosion of 1-1/2 miles of shoreline, and when you project that to the total shoreline that we are talking about, if that is a valid projection, you can see at least the nature of the expenditures that have to be made unless we come out with some other kinds of preventive measures to stop this.

MR. PURDY: Well, I agree with you that it is a very difficult problem and I was hoping that you could offer some advice and we could gain from your experience here.

MR. FRANGOS: I think the key, really, is whether the U. S. Department of Agriculture is developing programs that more directly address themselves to water quality problems.

MR. MACKIE: I might add that the work that has been done in the Whittlesey watershed by way of a demonstration project indicates that while much of this work is very, very expensive, there is an awful lot that can be done without this large expense.

MR. PURDY: That is all I have, Mr. Chairman.

MR. STEIN: Are there any other comments or questions?

MR. MAYO: I have a question to ask Mr. Frangos.

On page 3 of your report you talked about extending some dates to May of 1972.

MR. FRANGOS: Yes, sir.

MR. MAYO: Would these dates be beyond the dates established in the water quality standards for compliance?

MR. FRANGOS: Well, I will answer the question this way. The reason we have gone to this procedure, there are indications to us that these dates will not be met, but we anticipate that we will know precisely what the status is out of these proceedings that we describe to you in this report. In this connection, particularly in the public hearings that we are going to be holding, we would invite your participation in these hearings.

MR. MAYO: As I understand the situation, take

Ashland for example, under the water quality standards at the present time the abatement schedule date for Ashland would be October 1, 1970?

MR. FRANGOS: That is correct.

MR. MAYO: Now, apparently, it is your impression that Ashland likely will not meet that date?

MR. FRANGOS: That is also correct, right.

MR. MAYO: And you are suggesting here that it may be desirable to extend that compliance date to May of 1972?

MR. FRANGOS: No, I don't know that. I would say that that would be the outside of any kind of extension if it were to be given, but the purpose of these hearings really are prompted by our anticipatory considerations that makes this look very doubtful at this time.

MR. STEIN: Well, I think this rates as a key question, which is going to be of interest to all the States, and here is the problem. I think we, in a sense, have met this issue when we set dates at conferences and then there is a proposed extension of a default. What we do is have another session of the conference and we consider that. As Mr. Purdy has known, we have taken up these questions time and time again at the conferences.

However, I think we have a new element added here and that is the element of water quality standards where you have a lot of dates.

Maybe the way they state this question in Washington is a more colorful statement, but I will use the expression they use, and that is "unilateral extension by the States when both the State and Federal Government signed off on these as reasonable dates."

Now, what do you do? I hate to pick Ashland except it starts with A. What do you do if you find that you are going to recommend an extension of that date in Wisconsin? Are you then going to consult with the Federal people and attempt to get a modification of this in the standards program? Or are you going to go ahead and then present us with--I find the embarrassing thing of at least a technical violation of the standards and people asking me to file a 180-day notice to take them to court?